









H2O SONGSONG JERAI EXPEDITION 2017

CREATING A CORRIDOR OF LIFE AND BIODIVERSITY

A Proposal for New Marine Park in Kedah

Aileen Tan Shau Hwai
Zulfigar Yasin
Ab. Rahim Gor Yaman
Abd. Muntalib Juli
Albert Apollo Chan
Nithiyaa Nilamani









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Publisher
Department of Fisheries Malaysia
Ministry of Agriculture and Agro-Based Industry
Marine Park and Resource Management Division
Level 3, Wisma Tani
No. 30 Persiaran Perdana, Precinct 4
62628 Putrajaya, Malaysia
Tel: 03-8870 4005, Fax: 03-8881 1086
http://www.dof.gov.my
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ISBN 978-967-0633-66-4

Bibliography Citation
Aileen Tan Shau Hwai, Zulfigar Yasin, Ab. Rahim Gor Yaman, Abd. Muntalib Juli, Albert Apollo Chan, Nithiyaa Nilamani, 2019, H20 Songsong Jerai Expedition 2017 - Corridor of Life and Biodiversity : A Proposal for New Marine Park in Kedah, Marine Park and Resource Management Division, Department of Fisheries, Ministry of Agriculture & Argo-based Industry, Putrajaya, Malaysia. 108 pp.

Cover and content photos courtesy to:
Annette Jaya Ram, Sim Yee Kwang, Nithiyaa Nilamani, Mahadi Mohammad, Nadthikphorn Kamphol, Leela Rajamani, Zarul Hazrin Hashim, Siti Munirah, M.Y, Ummul Nazrah, A.R.,Angan, A., Ooi Im Hin, Sivakumaran Vasu Deva, Masnizar Mislan, Mohd Shafawi Ibrahim, Nur Duratunnisya Abdullah, Zulfigar Yasin, Norhanis M. Razalli, Aileen Tan , Rahimi Abidin, Hazlinda Hassan, Jafni Azhan Ibrahim, Azami Mohd Zain, Tan Choo Eng, Albert Apollo Chan, Kanda Kumar

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

H2O Songsong Jerai Expedition (2017 : Kedah)
H20 SONGSONG JERAI EXPEDITION 2017 : CREATING A CORRIDOR OF LIFE AND BIODIVERSITY : PROPOSAL FOR A NEW MARINE PARK IN KEDAH /
Editors: Aileen Tan Shau Hwai, Zulfigar Yasin, Ab. Rahim Gor Yaman, Abd. Muntalib Juli, Albert Apollo Chan.
ISBN 978-967-0633-66-4
1. Marine parks and reserves--Malaysia--Pulau Songsong (Kedah).
2. Government publications--Malaysia.
I. Tan, Aileen Shau-Hwai. II. Zulfigar Yasin.
III. Ab. Rahim Gor Yaman. IV. Abd. Muntalib Juli.
V. Chan, Albert Apollo. VI. Judul.
333.956160720595112

Printed in Malaysia by
MAZIZA SDN BHD (84548-W)
No. 9 & 11, Jalan 111 (Helang Sewah),
Kepong Baru, 52100 Kuala Lumpur

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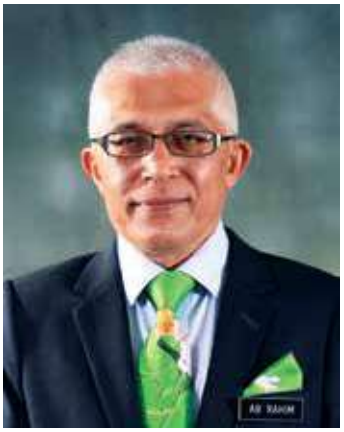

Haji Ab. Rahim bin Gor Yaman
Senior Director
Marine Park and Resource Management Division
Department of Fisheries Malaysia
PUTRAJAYA

As Malaysia enters the 21st century, there are tremendous pressure that set upon on the marine environment especially towards the protected areas. The stressor comes in many forms such as habitat loss, invasive species, over harvesting, reduce fishery stocks, pollutions and many more. These are exacerbate with the climate change (CC) agendas and the indicators of the present of CC effects have already been felt in our Malaysian marine parks. The department seek to undertake proactive steps in making sure the protection of Malaysia last protected marine areas are given high priority so as to secure the future generations wellbeing. By expanding these marine protected areas (MPAs) and making sure they are connected to each other, will ensure that highest resilience toward the impending CC negative stressors are met upon head on. Preparation such as these will become a norm to every level of the society and organization which depended to the marine environment.

I would like to take this opportunity to congratulate the USM teams especially my highest regards to Professor Aileen and Professor Zulfigar of CEMACS, USM for taking charge and becoming the lead organization in making sure the numerous data are collected and archived accordingly and presented in this wonderful published book. Grant me too to take my heads off to all the government agencies and NGOs that had tirelessly supported us from the highest peak of Mount Jerai to the bottom of the sea of Songsong's islands. And finally not forgetting my dedicated officer and staffs that work diligently in making sure all the preparation goes smoothly and successfully during the Biodiversity Expedition. Our last wish that these stretch of Kedah's waterway will be fully supported by the state authority, in turning it into a Marine Park for the good and worthy cause in securing our future generation welfare and prosperity.

Thank you.

Foreword

Prof Dato' Dr Aileen Tan Shau Hwai
Director
Centre for Marine and Coastal Studies (CEMACS)
Universiti Sains Malaysia (USM)

The H2O (Highland to Ocean) Songsong-Jerai expedition that sailed in September 2017 was jointly organised by the Department of Marine Parks Malaysia (DMPM) and Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia, which aimed to look at the biodiversity of both marine and terrestrial flora and fauna of the areas. I greatly admire the commitment of all the expedition members who had made this expedition a great success despite the rough and unpredictable weather.

This expedition managed to foster a sense of appreciation for our heritage, strengthen collaboration effort between government agencies as well as non-governmental organisations (NGO), rediscovered and revealed the uniqueness of the nature through scientific discoveries, and finally knowledge transfer to the society and younger generation. Scientific expedition such as above should be our legacy, especially to a country that is rich with its natural and cultural heritage.

Centre for Marine and Coastal Studies, better known as CEMACS, has and will be more actively navigating ocean science, particullarly on the benthic organisms following the footsteps of the past legacies who had lead the country's major expeditions such as the ROSES Expeditions to South China Sea in 2004, Expeditions to Antarctica since 2004 and the Sulu and Sulawesi Prime Expeditions 2015. Being the oldest marine center in Malaysia, CEMACS will continue be a platform that contribute scientific knowledge and solution that will help the community and nation to be parrellel to the changing world due to climate change and threats to this country's biodiversity.

I would like to take this opportunity to thank all the members who have contributed in making the H2O Songsong-Jerai Expedition book publication possible. It is my great hope and expectations that this book will provide a referenced resource to the local and federal government in the effort of gazetting Pulau Songsong as a marine park, the second in the Straits of Malacca for a more sustainable environment.

Thank you.

Foreword

Prof Zulfigar Yasin
Expedition Leader
School of Biological Sciences
Universiti Sains Malaysia (USM)

The Songsong-Jerai Highland to Ocean Expedition was expected to initiate the documentation of the diverse marine and coastal components of the habitats, biological communities and special areas of conservation in the area. The marine component comprises of the islands, coral reefs and nearshore habitats especially that of Pulau Bidan, Pulau Telur, Tukun Terendak and Pulau Songsong. The land component that of the special areas of Gunung Jerai and its neighboring areas.

The expedition followed the cooperation of nine institutions from the state and federal levels of nearly fifty scientists and social scientists who gathered at the Centre for Marine and Coastal Studies, Universiti Sains Malaysia for the planning and execution of the project. It was sponsored by the Department of Marine Parks Malaysia with the support of Universiti Sains Malaysia. This was initiated in July 2017.

The expedition proper commenced for 8 days in late September 2017 in fair weather. The results were indeed interesting pointing to the rich biodiversity of the area both in the terrestrial and marine habitats. In the trails adorning Gunung Jerai were large dipterocarp trees, endangered orchids and pitcher plants. Of the islands - Pulau Songsong proved to be the most diverse in marine life. This may be due to relatively larger areas of fringing reef habitats that surround most of the islands. Special reef animals such as the “gamat” – *Stichopus fusiformiossa* can still be found here, as are shoals of commercial fish species such as the groupers and jacks.

But this study also points to another important fact. Compared to its former self Pulau Songsong is declining in it biological richness. Universiti Sains Malaysia has been studying the area since the mid 1980’s and a comparative review of the coral distribution points to a decrease in the areas now inhabited by coral reefs. The condition of the reef is also deteriorating much due to the increase level of sedimentation from the mainland. Other harmful incidences were seen during the expedition such as the widespread occurrence of red tide – an algal bloom in the marine waters due to nutrient pollution from mainland Kedah.

The islands area still rich in marine biodiversity and natural resources and its habitats still remain a fisheries refugia protecting the marine staples of Kedah. This was evidenced from the schools of commercial fishes observed during the dives at Pulau Songsong and Tukun Terendak - an offshore rocky outcrop. Where would Kedah fisheries be without these islands and reefs.

The expedition in my opinion has fulfilled its objective in initiating the collective study and assessment of marine biodiversity. It would be impossible to carry out a comprehensive auditing of the total diversity in this short period but the results here are promising. Given such an important position that these coastal habitats play in the conservation of Kedah’s natural resources it would be prudent to consider its protection under the law.

Special thanks goes to the many personnel, scientists and institutions (especially Jabatan Taman Laut Malaysia and CEMACS, USM) for their tireless support for making the Expedition a success.

Contributing Authors and Institutions

This report was compiled from six institutes, produced in partnership with the Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia (USM) and Marine Park and Resource Management Division, Department of Fisheries Malaysia. Many other research institutions, universities contributed data, reviewed results, scientific guidance and shared images for these reports, including:

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Acknowledgements

This publication would not have been possible without the help of a large number of individuals and institutions. Firstly, we would like to extend our sincere thanks to the Department of Marine Park Malaysia for their encouragement, and support extended towards publishing this book.

We also thank all the researchers and members from Universiti Sains Malaysia (USM), Universiti Utara Malaysia (UUM), Forest Research Institute Malaysia (FRIM), Department of Wildlife and National Parks (PERHILITAN), Forestry Department, Malaysia Nature Society (MNS) Penang, and Penang Botanical Garden (PBG) who had contributed to the report and photographs used in this publication. Our gratitude to the Kedah State Forest Department and District Office of Yan for the permit and also the crew members of MV Delisha for a smooth sailing throughout the expedition.

Special appreciation dedicated to Dr Annette Jaya Ram for proofreading the publication.

This research was supported by the grant from the Department of Marine Parks Malaysia (project 304/PP/650901/J122).

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CHAPTER 1

INTRODUCTION

1.1 Project background

The H2O (Highland to Ocean) Songsong-Jerai Expedition was jointly organised by the Department of Marine Parks Malaysia and Universiti Sains Malaysia's Centre for Marine and Coastal Studies (CEMACS) to document marine and terrestrial flora and fauna species of the area. The study area encompasses the land area of Gunung Jerai, the coastal and marine region of the Songsong group of islands in the state of Kedah. The main objective of the expedition is to see the possibility of the surveyed area to be gazette as a Marine Protected Area (MPA). In addition, contributing sufficient content for the publication of a book on Songsong-Jerai biodiversity.

Experts from various fields of biodiversity research were invited to join the expedition, and resulted in an outstanding number of interested participants volunteering. Members of the group comprised of experts from universities, government agencies, non-governmental organizations (NGO) and individual researchers.

The expedition itself is divided into the Land Component and the Marine Component (Figure 1.1.1). The former focused on Gunung Jerai and the terrestrial areas of the islands whilst, the latter concentrated their studies on the seas.

Figure 1.1.1. The Songsong group of islands lies in close proximity to Gunung Jerai on peninsular Malaysia.

1.2 Expedition planning and management

Preparation for the expedition began in early 2017 calling on interested participants, with the first general meeting held at CEMACS, USM on 14th August 2017. The project initiator is the Department of Marine Parks Malaysia with CEMACS as secretariat and planner.

The Songsong-Jerai Expedition 2017 commenced from 26th September to 3rd October 2017. Kicking off were the marine expeditioners on board the MV Delisha. It transited from Kuala Kedah towards Pulau Songsong in fair weather. On board were the dive teams and scientists studying the coral reefs and intertidal areas of Pulau Songsong.

The terrestrial teams were based in Yan, Kedah. The initial stages of the expedition saw them visiting the coastal areas of Songsong group of islands (Pulau Songsong, Pulau Bidan, and Pulau Telur) from Tanjung Dawai jetty on the mainland.

Another team consisting of Ichthyologists (fish group) and the marine mammal group had its base in CEMACS, Penang. They commuted to Pulau Songsong and also delivered samples back to the centre for safekeeping. MV Delisha returned to Kuala Kedah on 29th September 2017. The marine expeditioners returned to CEMACS where the scientists continued with their analyses.

Meanwhile the land group started their investigation on the biodiversity at Gunung Jerai. The land group comprised of zoologists, botanists and social scientists. Activities on sampling and observations ran from morning to late at night. Forestry Department and the District Office of Yan were advisory to the research here.

1.3 Project progress timeline

The project timeline is shown in Table 1.3.1 below. Sampling activity for the marine component has been completed at Pulau Songsong and Tukun Terendak from 27th to 29th September 2017. Prior to the expedition, six meetings have been conducted with the researchers as follows:

1st meeting: 14th August 2017

2nd meeting: 25th August 2017

3rd meeting: 30th August 2017

4th meeting: 7th September 2017

5th meeting: 15th September 2017

6th meeting: 25th September 2017

Table 1.3.1. Songsong-Jerai Expedition timeline.

Activities	July 2017	Aug 2017	Sept 2017	Oct 2017	April 2018
Appointment letter to researchers					
Meeting for researchers (marine component)					
Allotment of budget					
Preparation before sampling					
Sampling activity					
Analysis of research					
Final presentation of the research project					

1.4 The expedition team and areas of expertise

Altogether nine agencies were involved with the Songsong-Jerai Expedition. These comprised of government agencies, universities, NGOs and private researchers from all over the country. The agencies involved are:

1. Universiti Sains Malaysia
    i. CEMACS
    ii. School of Biological Sciences (SBS)
2. Department of Marine Parks Malaysia
3. Universiti Utara Malaysia (UUM)
4. Forest Research Institute Malaysia (FRIM)
5. Department of Wildlife and National Parks (PERHILITAN)
6. Forestry Department
7. Fisheries Research Institute (FRI) Batu Maung
8. Malaysian Nature Society (MNS) Penang
9. Penang Botanical Garden (PBG)

Other institutions were invited to be in the expedition due to their expertise in certain areas. The presence of other scientists from other institutions would make this expedition more successful with the combination of various expertise, knowledge and

experiences relevant to this expedition. Table 1.4.1 below shows the list of expeditioners involved in the H2O Songsong-Jerai expedition.

Table 1.4.1. List of expeditioners involved in the H2O Songsong-Jerai expedition.

No.	Researchers	Institutions	Area of expertise
Marine Component			
1	Prof Zulfigar Yasin	USM	Coral reef biologist/Expedition Leader
2	Prof Dato' Dr Aileen Tan Shau Hwai	CEMACS	Malacologist/Expedition Leader
3	Dr Mahadi Mohammad	USM	Marine Biologist
4	Dr Annette Jaya Ram	CEMACS	Crustacean
5	Dr Chee Su Yin	CEMACS	Molecular Biologist
6	Dr Norlaila Binti Mohd Zanuri	CEMACS	Marine Toxicologist
7	Dr Leela Rajamani	CEMACS	Cetacean biologist
8	Dr Zarul Hazrin Hashim	USM	Ichthyologist
9	Lim Er Vin	CEMACS	Pollution Biologist
10	Muhammad Lutfi Bin Haron	MSL (USM)	Coral Ecologist
11	Nadthikphorn Kamphol	USM	Coral Taxonomist
12	Nithiyaa Nilamani	CEMACS	Coral Ecologist
13	Norhanis Bt Mohammad Razalli	MSL (USM)	Coral Ecologist
14	Noorsyarmalaila binti Ramli	CEMACS	Cetacean biologist
15	Sim Yee Kwang	CEMACS	Echinoderm biologist
16	Wong Swe Cheng	CEMACS	Crustacean
17	Abdul Latif Bin Omar	CEMACS	Dive Marshal
18	Rosly Basarudin	CEMACS	Technical staff
19	Rajindran Suppiah	CEMACS	Support staff
20	Ermizan Bin Suki	USM	Support staff
21	Mohd Hafizul Hasmadi	USM	Support staff

Table 1.4.1. (Continue)

No.	Researchers	Institutions	Area of expertise
Terrestrial Component			
22	Albert Apollo Chan	JTLM	Expedition Leader
23	Dr Rahimi Binti Abidin	UUM	Socioeconomy
24	Dr Jafni Azhan Bin Ibrahim	UUM	Socioeconomy
25	Dr Hazlinda Binti Hassan	UUM	Socioeconomy
26	Azami bin Md Zain	UUM	Socioeconomy
27	Tan Choo Eng	MNS(Penang)	Ornithologist
28	James Ooi Teik Kok	MNS(Penang)	Ornithologist
29	Kumaradevan Saminathan	CEMACS	Botanist
30	Siti Munirah Bt. Mat Yunoh	FRIM	Botanist
31	Ummul Nazrah Abdul Rahman	FRIM	Botanist
32	Angan Atan	FRIM	Botanist
33	Sivakumar Vasudevan	PBG	Botanist
34	Ooi Im Hin	PBG	Botanist
35	Masnizar bin Mislan	Perhilitan	Herpetofauna
36	Mohd Shafawi bin Ibrahim	Perhilitan	Herpetofauna
37	Nur Duratunnisya binti Abdullah	Perhilitan	Herpetofauna
38	Mohamad Saupi Bin Ismail	FRI Batu Maung	Coral reef ecology-Seahorse
39	Siti Sarah Mohd Jamil	FRI Batu Maung	Coral reef ecology-Seahorse
40	Yusri bin Md Yusof	CEMACS	Support staff
Others			
41	Nooraini Ilias	USM	Secretariat
42	Mohd Rahim bin Ramli	J. Perhutanan Negeri Kedah	Deputy Director (Operation)

CHAPTER 2

RESEARCH FINDINGS

2.1 GEOMORPHOLOGY AND MICROHABITATS OF EASTERN PULAU SONGSONG

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Introduction

Pulau Songsong located about 16 km west of Tanjung Dawai on the mainland of Kedah is located in the Straits of Malacca. It is a frequent stop for the fisher folks from the nearby coastal villagers where the sea provides fish and food. There are coconut groves and several large breadfruit trees on the flatlands. Trawlers too illegally frequent the area. Pulau Songsong has recently attracted a growing number of tourists especially from Penang and the mainland Kedah.

The Study Area and the Geomorphology of Pulau Songsong

The island of Songsong (Literal translation from Hokkien: 'Happy') lies in shallow tropical seas and is surrounded by several types of coastal habitats. The exposed western area comprise of rocky steep cliffs that's are covered with land vegetation that was previously logged. This extends to the north and south of the island. There is a small beach to the southwest. On the west, there are two caves that are partially tidal. The largest reef area is found to the south of Pulau Songsong. It is a fringing reef but was not diveable during the expedition due to the rough seas. Figure 2.1.1 provides a generalized view of Pulau Songsong. The largest beach is found fronting the east part of the island with a rocky shore to its north. This is the main study location.

Figure 2.1.1. Overall view of Pulau Songsong.

Determination of Microhabitats

We can divide the microhabitats found here into the terrestrial section and the marine section. Figure 2.1.2 illustrates the cross sectional profile of eastern Pulau Songsong from the steep terrestrial slopes towards the marine areas beyond the coral reef.

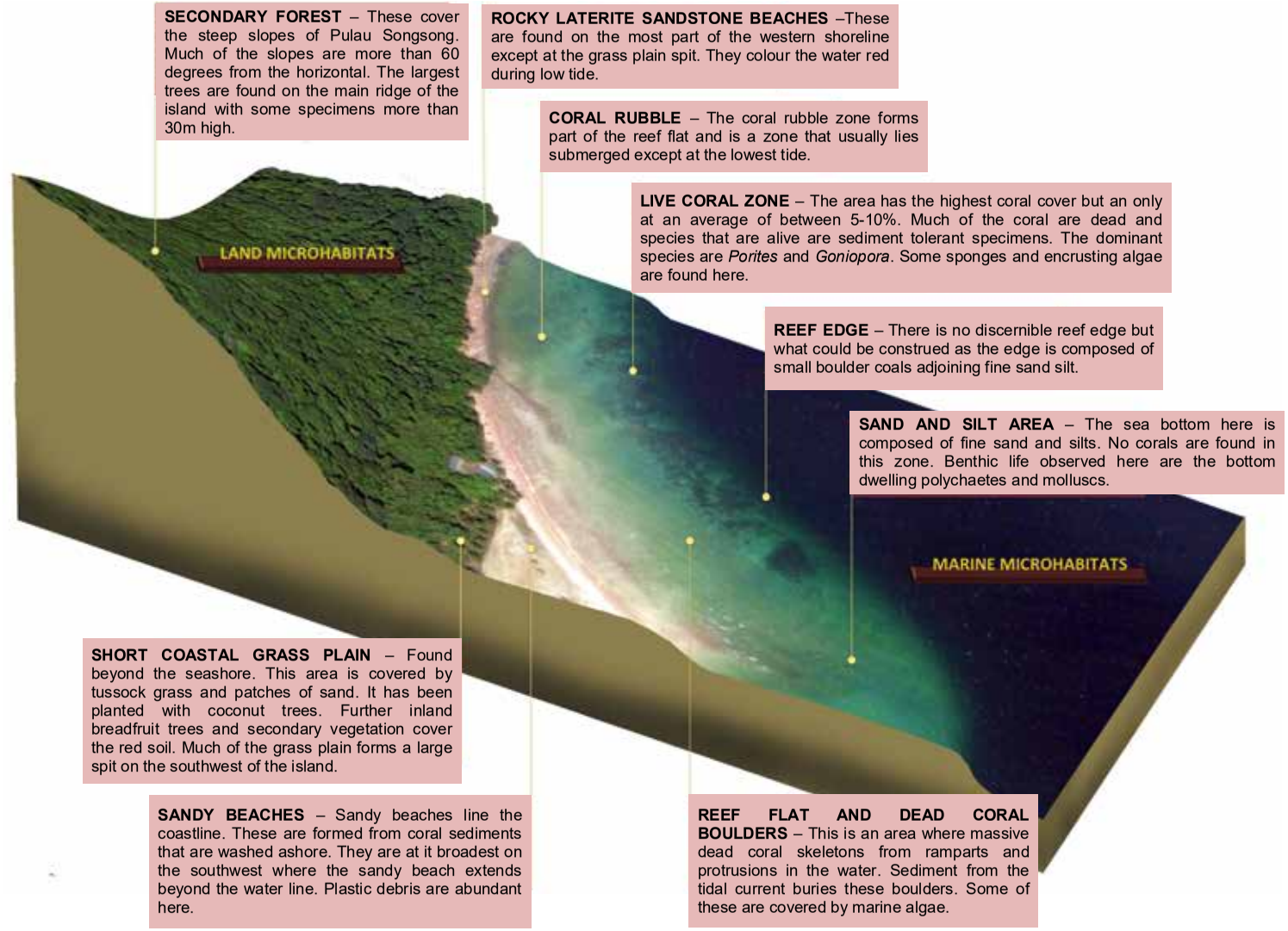

Figure 2.1.2. Illustrates the cross-sectional profile of eastern Pulau Songsong.

2.2 PRELIMINARY DIVERSITY CHECKLIST OF MACROFAUNA AT CORAL REEFS AND INTERTIDAL ZONE OF PULAU SONGSONG, KEDAH.

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Abstract

A total of 105 macrofauna were collected from coral reef and intertidal zone of Pulau Songsong, Kedah. The organisms encompassed 6 different phyla, namely Porifera, Echinodermata, Sipuncula, Annelida, Mollusca and Arthropoda. The largest number of organisms collected was from the class Ophiuroidea which represent the brittle stars. Molluscans were mainly represented by several species of gastropods and bivalves which were found encrusted deeply within the crevices of the coral boulders. Arthropods collected were decapod crustaceans such as portunid and grapsid crabs along with pistol shrimps. A single amphipod specimen was also documented during the sampling. Sea urchins collected were sampled and kept as live specimens. Other samples were immersed in alcohol for long term storage or for DNA barcoding studies.

Introduction

The condition or status of an ecosystem can be determined by understanding the diversity and interactivity of its organisms. A tropical coral reef ecosystem is a highly diverse habitat with many species of flora and fauna. Marine organisms are part of the complex food webs in the coastal, seagrass beds and coral reefs ecosystems where they can be predators, prey or detritus consumers. Some species also contribute towards human consumption and economic revenue to fishermen and farmers. The coral reef ecosystem is also one of the attractions of eco-tourism. In the field of ecological engineering, reefs act at natural barriers to harsh waves, prevent erosion, property damage and loss of lives. Perhaps more importantly, in present times, coral reefs function as a bioindicators for anthropogenic activities (e.g. land-based runoff and pollutant discharges), climate change and ocean acidification. Coral reefs should be protected to preserve their biodiversity, their ecological functions and roles they play. Studies on diversity and abundance allow identification of species in need of conservation and provide an estimate to the magnitude of efforts needed for their conservation. A preliminary diversity checklist of the macrofauna which inhabit the coral reefs and the intertidal zone at Pulau Songsong was determined by sampling several coral boulders and visual beach scanning. The specimens collected were also stored for future DNA barcoding studies.

Objectives

1. To identify the diversity of macrofauna in the coral reef and intertidal zone of Pulau Songsong, and

2. To obtain specimens for DNA barcoding studies.

Materials and Methods

(a) Sampling of coral boulders

Samples of coral boulders were collected by means of SCUBA diving at the east of Pulau Songsong (5.811728°N, 100.297099°E). A total of fifteen coral boulders were extracted manually using chisel and hammer. Each coral boulder was secured in individual bags and carried up to surface for further analysis. The coral boulder was scanned visually for organisms which may be attached externally and removed for identification and DNA barcoding analysis. The coral boulder was then immersed in 10% magnesium chloride in clean sea water (w/v) solution for 10 minutes to ensure relaxation of organisms such as molluscs and crustaceans. The usage of the magnesium chloride solution prior to ethanol immersion was also to avoid autotomy of crustacean limbs due to sudden stress in change of environment. During the magnesium chloride bath, organisms which released themselves from the crevices of coral boulders were collected with forceps and kept in 99% ethanol. Subsequently, organisms which adhered or bored deep into the crevices of coral boulders were removed with the aid of hammer and chisel. All organisms were then placed in individual vessels filled with 99% ethanol for DNA barcoding studies.

(b) Sampling of sea urchins

All sea urchins were collected from the shallow coral reef areas northeast of Pulau Songsong (5.812491°N, 100.296166°E). SCUBA diving was employed for sea urchins collection. Sea urchin specimens were kept alive on board and transported to the wet lab.

(c) Intertidal zone visual scan and collection of organisms

The intertidal zone was also visually monitored for diversity of crab species. The monitoring covered the length of the accessible sandy shore and rocky shore area. Crabs which were observed were captured using a handheld net and stored in ice prior to identification.

(d) Identification of organisms

All organisms found on coral boulders were photographed and classified to the lowest taxon possible according to identification keys and references available.

Results

Table 2.2.1. Selected macrofauna obtained from coral boulders at Pulau Songsong, Kedah.

No.	Phylum	Classification
	Echinodermata	
1.	 	Common name: Brittle star Class: Ophiuroidea Order: Ophiurida Family: Amphiuridae/Ophiactidae Genus: *Amphipholis*/*Ophiactis* Species: *A. squamata*/*O. savignyi*
2.	 	Common name: Black long-spine urchin Class: Echinoidea Order: Diadematoida Family: Diadematidae Genus: *Diadema* Species: *D. setosum*
	Annelida	
1.	 	Class: Polychaeta

Table 2.2.1. (Continue).

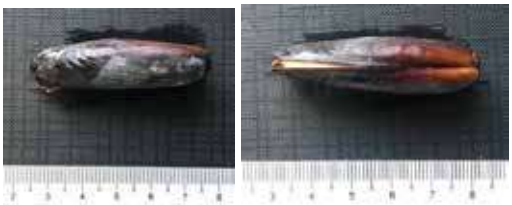
No.	Phylum	Classification
	Annelida	
2.		Class: Polychaeta Order: Phyllodocida Family: Phyllodocidae
3.		Common name: Scale worm Class: Polychaeta Order: Phyllodocida Family: Polynoidae Genus: *Parapidonotus*
	Sipuncula	
1.		Identification pending.
	Mollusca	
1.		Class: Bivalvia Order: Mytiloida Family: Mytilidae Genus: *Leiosolenus* Species: *L. lima*
2.		Class: Bivalvia Order: Mytilida Family: Mytilidae Genus: *Septifer* Species: *S. cumingii*
3.		Class: Bivalvia Order: Mytiloida Family: Mytilidae Genus: *Lithophaga* Species: *L. teres*

Table 2.2.1. (Continue).

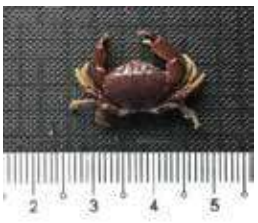
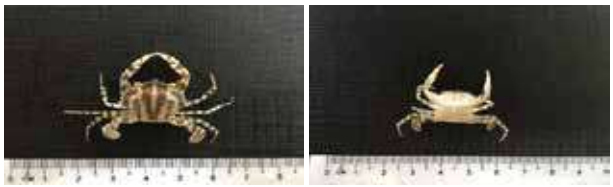
No.	Phylum	Classification
	Mollusca	
4.		Class: Gastropoda Order: Neogastropoda Family: Muricidae Genus: *Morula*
	Arthropoda	
1.		Subphylum: Crustacea Class: Malacostraca Order: Decapoda Family: Xanthidae
2.		Common name: Pistol shrimp Subphylum: Crustacea Class: Malacostraca Order: Decapoda Family: Alpheidae Genus: *Alpheus*

Table 2.2.2. Decapod crustaceans found in the sandy and rocky shore intertidal of Pulau Songsong.

No.	Phylum	Classification
	Arthropoda	
1.		Common name: Ghost crab Subphylum: Crustacea Class: Malacostraca Order: Decapoda Infraorder: Brachyura Family: Ocypodidae Genus: *Ocypode*
2.		Common name: Lightfoot crab Subphylum: Crustacea Class: Malacostraca Order: Decapoda Infraorder: Brachyura Family: Grapsidae Genus: *Grapsus*
3.		Common name: Crucifix crab Subphylum: Crustacea Class: Malacostraca Order: Decapoda Infraorder: Brachyura Family: Portunidae Genus: *Charybdis* Species: *C. feriatus*

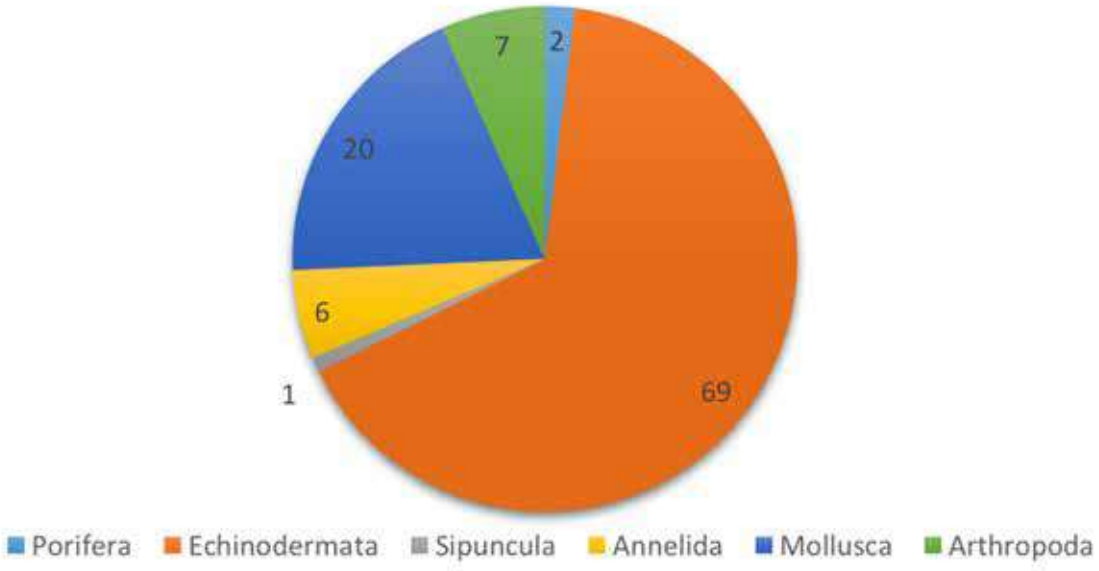


Figure 2.2.1. The abundance of organisms collected from coral reefs and intertidal zone of Pulau Songsong classified by phyla.

Discussion

A total of 105 macrofauna was collected from coral boulders and the intertidal zone of the study site. The organisms found belong to the phyla of Porifera, Echinodermata, Sipuncula, Annelida, Mollusca and Arthropoda. Highest number of organisms collected were brittle stars belonging to the phylum Echinodermata. Within the molluscan phylum, 18 organisms found belonged to the class Bivalvia, and the remaining to the class Gastropoda. The mussels bore into the corals and were located within crevices or keyholes within the corals belonging to the Poritidae family. Arthropods found in coral boulders were all crustaceans belonging either to the orders Amphipoda and Decapoda (crabs and pistol shrimps). Beach scanning also revealed 3 other species of crabs. The most common crab found on the sandy shore at the island was the ghost crab. On the other hand, a single type of grapsid crab was found at the rocky shore area. A juvenile crucifix crab was also captured while beach combing for crabs. The crucifix crab is an edible species and is one of the crab species available at seafood restaurants. The juvenile crab found in this area is an indication that there is population of these portunid crabs in the waters of Pulau Songsong. They are most likely to breed and use the coral reef areas as nursing ground which intensifies the importance of this ecosystem. Crabs are usually nocturnal and this preliminary diversity study was conducted during day light hours. Future studies could be conducted during the night to identify other species of crabs available in the same area.

Several polychaete worms were also extracted from the coral boulders but are unable to be identified to lower taxa at the time this report is being written. Polychaete identification is ongoing and will be included in future publication of this study. A total of 6 black long-spine sea urchin were collected from the coral reefs and kept as live samples. Sea urchins are a major component of marine communities and play an important ecological role. In areas with less herbivores, sea urchins feed on the algal biomass and results in the role of maintaining the balance between coral and algae. Another important element of sea urchins in coral ecosystem is their contribution to reef resilience. Sea urchins prevent the establishment of macroalgae hence, help maintain conditions for coral community to recover after severe disturbance such as bleaching events and storm thus, help to restore the reefs to a healthy state. The existence of sea urchins is valuable in the coral ecosystem and definitely benefits the coral reef of Pulau Songsong.

Recommendation

This preliminary study of the diversity of macrofauna revealed the various organisms which utilize the coral reefs of Pulau Songsong as their habitat. Each organism species plays its own role and interacts with the coral population at the area. It is recommended that follow up spatial and temporal studies be conducted at different times to fully discover the range and distribution patterns of organisms which inhabit the intertidal and coral reef ecosystems throughout the year. The diversity of macrofauna at coral reefs should be protected in order to preserve the symbiosis and maintain the balance of the marine ecosystem.

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2.3 SEA CUCUMBERS (ECHINODERMATA: HOLOTHUROIDEA) FROM PULAU SONGSONG, KEDAH

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Introduction

The Holothuroidea, or sea cucumbers, are an abundant and diverse group of worm-like and usually soft-bodied echinoderms. They are found in nearly every marine environment, but are most diverse on tropical shallow-water coral reefs. They range from the intertidal, where they may be exposed briefly at low tide, to the floor of the deepest oceanic trenches. Some of these are about 20 cm in length, though adults of some diminutive species may not exceed a centimeter, while one large species can reach lengths of 5 m (*Synapta maculata*). Several species can swim and there are even forms that live their entire lives as plankton, floating with the ocean currents.

The Holothuroidea, or sea cucumbers are very well represented in this region, both in numbers and in species (George & George, 1987). However, although the taxonomy of the sea cucumber families is generally well established, the distinction between similar species of sea cucumber is often difficult. Several new species have been described from the Indo-Pacific, which is the center of sea cucumber biodiversity (Bruckner *et al*., 2003). There are, however, still many un-described large species that are common in shallow waters.

The sea cucumber fauna of Malaysia has been dealt with in several publications: five families, nine genera, and 22 species of sea cucumber were recorded in the Bodgaya Islands and Pulau Sipadan, Sabah (George & George, 1987). Baine and Forbes (1998) recorded three unidentified *Stichopus* species as *Stichopus* sp. 1, *Stichopus* sp. 2, and *Stichopus* sp. 3, but these are not included in the report by Forbes & Ilias (1999). During the period from July 1996 to December 1998, six surveys were carried out in the Peninsular Malaysia and Sabah in order to determine species presence, abundance, and distribution. A total of 148 sites were surveyed and the biological habitats and relative abundance of sea cucumber species were described. A total of 37 species of sea cucumber were recorded with six species requiring verification. Species abundance, although relatively high at most locations, displayed considerable patchiness (Forbes *et al*., 1999).

Zulfigar & Tan (1999) recorded 36 species of sea cucumber occupying an extensive area on the fringing reefs of Pulau Tioman, Pahang, and four islands of the Johore Islands, located in the lower part of the South China Sea. Rizal Boss *et al*. (1999), Zulfigar *et al*. (2001a), and Massin *et al*. (2002) have provided lists of species found in the Johore Marine Park (South China Sea, Malaysia). A study of the holothurian genus *Stichopus* from Johore Marine Park revealed seven different species, and two new species (*S. ocellatus* and *S. rubermaculosus*) were fully described and illustrated. A further species, *S. monotuberculatus*, had not previously been recorded in the Johore Marine Park. Two other reports (Zulfigar *et al*., 1999 and 2001b) dealt with the taxonomy of *S. hermanni* and *S. variegatus*.

Four families (Cucumariidae, Holothuriidae, Stichopodidae, and Synaptidae), 11 genera, and 33 species of sea cucumbers recorded from 32 different locations in Malaysian coastal waters from year the 2004 to 2009 were reported by Zulfigar *et al.*, (2008) and Sim & Kee Alfian (2011). Recently, five sea cucumber species including one new species of the genus *Stichopus* are reported from the shallow coral reefs of Straits of Malacca (Woo *et al*., 2015). The new species *Stichopus fusiformiossa* has unusual fusiform spicules in the tentacles, which are not found in the other species of the genus. Pseudo-tables and large perforated plates are newly recorded for *Stichopus hermanni* (Semper, 1868) and *Stichopus vastus* (Sluiter, 1887), respectively.

Economically, sea cucumbers are important in two main ways. First, some species produce toxins that are of interest to pharmaceutical firms seeking to learn their medical value. Some compounds isolated to date exhibit antimicrobial activity or act as anti-inflammatory agents and anticoagulants. Second, as a gourmet food item in the orient, they form the basis of a multimillion-dollar industry that processes the body wall for sale as béche-de-mer or *trepan* (Baine & Choo, 1999). However, the high value of some species, the ease with which such shallow-water forms can be collected, and their top-heavy age structures all contribute to over-exploitation and collapse of the fisheries in some regions. Fishermen in the Pacific islands use the toxins, some of which act as respiratory inhibitors, to entice fish and octopus from crevices so that they may be more easily speared. Furthermore, the sticky cuvierian tubules are placed over bleeding wounds as a bandage.

Materials and Methods

Sea cucumbers were collected from the shallow coral reef areas of Pulau Songsong and Tukun Terendak in the Straits of Malacca as shown in Figure 2.3.1. The sampling areas were situated in highly sediment waters of the Straits of Malacca (Chua *et al.*, 2000) with poor reef framework formation (Pillai & Scheer, 1974).

All sampling areas exhibited similar shallow reef flat at depths about 0.5 to 15 m with gradual slope of sandy substrate extending to 20 m depth. SCUBA diving was employed in collecting specimens using transect covering an area of about 100 m^2; up to 18m water depth during day and night. The sea cucumber specimens were fixed in absolute ethanol for two weeks and stored in 70% ethanol as a final preservative solution (Lincoln & Sheals, 1979) and stored in Centre For Marine and Coastal Studies, Universiti Sains Malaysia, for future examinations.

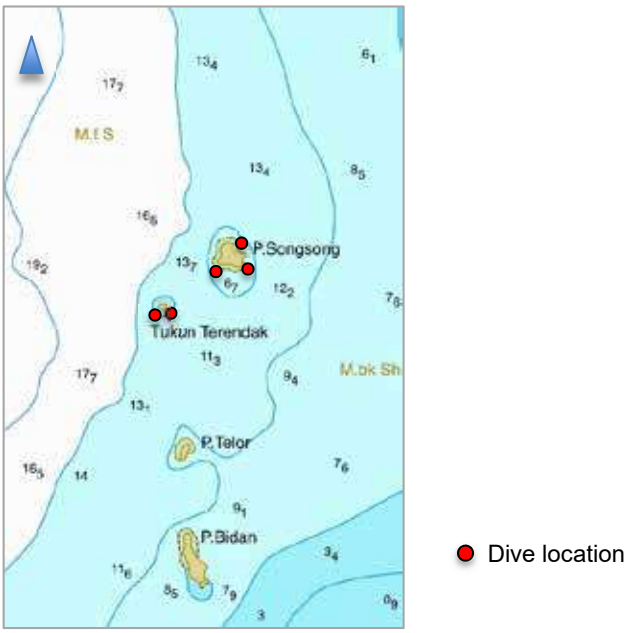

Figure 2.3.1. Map of study area in the Straits of Malacca: Pulau Songsong and Tukun Terendak.

Results and Discussion

The list of sea cucumber species collected from the survey was shown in Table 2.3.1. A total of two families (Holothuriidae and Stichopodidae), two genera and only two species were recorded during survey period (27th to 29th September 2017). *Holothuria (Mertensiothuria) leucospilota* (Figure 2.3.2) was the dominant sea cucumber species in this survey area with abundance of 12.85 ind./100 m^2 meanwhile *Stichopus fussiformiossa* (Figure 2.3.3) consider rare and only found at the northern (2.12 ind./100 m^2) and southern part (5.56 ind./100 m^2) of Pulau Songsong.

Table 2.3.1. The diversity of sea cucumbers from Pulau Songsong, Kedah.

No	Species	Distribution	Behaviour	Substrate	Depth (m)
1	*Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835)	Pulau Songsong; Tukun Terandak	Diurnal	Sandy with rubble	0 - 5.5
2	*Stichopus fusiformiossa* (Woo, 2015)	Pulau Songsong	Nocturnal	Coral rubble & rocky hard substrate	3.5 – 11.2

Figure 2.3.2. The habitat and morphology of *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835) (Holothuroidae; Family Holothuriidae) collected during the expedition.

Figure 2.3.3. The habitat and morphology of *Stichopus fusiformiossa* (Woo, 2015) (Holothuroidae; Family Stichopodidae) collected during the expedition.

For other Echinoderms, only black long-spines sea urchin *Diadema setosum* (Leske, 1778) was observed at coral rubble and rocky hard substrate in both islands. Eastern Tukun Terendak recorded the highest abundance of *D. setosum* (36.76 ind./100 m^2) at depth of 5 to 8 m. No sea star, brittle star and sea urchin found in survey area. Marine biodiversity expedition to Songsong group of Islands in year 2012 reported three families (Holothuriidae, Stichopodidae and Synaptidae), four genera and eight species of sea cucumber in Pulau Kaca, Pulau Segantang and Pulau Songsong, Straits of Malacca (Zulfigar *et al.*, 2013). *H. leucospilota* and *Synaptula lamperti* were found in Pulau Songsong according to the report; only *H. leucospilota* was found during this survey and *S. lamperti* (small skinny with length 5-10cm long) which normally found in large numbers and draped around sponges and other encrusting animals was not recorded in any survey sites during this expedition.

Recommendations

Overall, the diversity of Echinodermata in the Pulau Songsong was consider low; it might be due to the trawling activities at nearby area and over-harvesting of commercial *Stichopus* spp. by local fishermen during low tide. Gazetting Pulau Songsong archipelago as Marine Park might be the only solution to maintain & increase the population of sea cucumbers and other echinoderms in this area.

Acknowledgements

The authors would like to thank Jabatan Laut Malaysia for the expedition funding; the authority of Kedah State Government for allowing the sampling team to carry out sampling in the vicinity of the islands; and research diving team: Dr. Mahadi Mohammad, Mr. Abdul Latif Omar, Ms. Nithiyaa Nilamani; Ms. Norhanis Mohd. Razalli and Mr. Muhammad Lutfi Haron who assisted us during the sampling trips.

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2.4 THE DIVERSITY OF HARD CORALS AT PULAU SONGSONG, NORTHERN STRAITS OF MALACCA

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Introduction

Scleractinian corals are known as reef building corals due to their solid, massive and encrusting structural formation. The Indo-Pacific region, particularly the sea surrounding the Peninsular Malaysia, Philippines and Indonesia, is considered to contain the greatest species diversity of corals in the world. This geographically advantaged location provides an ideal atmospheric condition for the corals to live. Reef building corals are the representatives of a substrate level where it provides base to the other associated faunal communities. Being a complex and diversified ecosystem, coral reefs provides food, shelter, and also an important source of income to the people living at the coast. Diversification of hard coral acts as an indicator to a biologically enriched marine environment. This report presents the findings of the survey conducted on the status of hard coral diversity at Pulau Songsong during the H2O Songsong-Jerai Expedition 2017.

Material and methods

Several extensive undersea surveys were conducted at Pulau Songsong from 27th to 29th September 2017 to study the hard coral diversity using Self Contained Underwater Breathing Apparatus (SCUBA) diving and snorkeling. Underwater photographs and specimens were collected for detailed morphological identification. The sampled specimen was bleached with domestic bleaching agent for a day and washed thoroughly with running water to remove all the tissues and later oven dried at 60°C for 2 to 3 days. Identification until species level was made following the keys of Searle (1956), Pillai & Scheer (1974), Green et al. (1979), Betterton (1981), and Veron (2000). On completion of detailed structural study, the specimens were labeled and deposited at the Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia.

Result and Discussion

The list of hard corals collected during the XPDC H2O Songsong-Jerai 2017 is shown in Table 2.4.1 and Figure 2.4.1. Pulau Songsong recorded 16 species, 13 genera and 9 families. Corals from the family Faviidae, Poritidae and Merulinidae were found to be dominant. The low number of specimens is due to the poor visibility, which restricted underwater photography and sample collection.

Studies on the hard corals at the Northern Straits of Malacca, west coast of Peninsular Malaysia are very limited, as the only available information are from Helen (1984) and past biodiversity expedition in the year 2012 at Songsong group of islands. Thus, this study provides an updated hard coral species list.

Table 2.4.1. A list of scleractinian coral recorded at Pulau Songsong.

Family	Genus	Species	Year	
			2012	2017 (This study)
			Pulau Songsong	Pulau Songsong
Acroporidae	*Acropora*	*sp.*	✔	✔
	Montipora	*sp.*	✔	
Agariciidae	*Pavona*	*danai*	✔	✔
Dendrophyllidae	*Turbinaria*	*mesenterina*	✔	✔
	Turbinaria	*sp.*		✔
Faviidae	*Cyphastrea*	*chalcidium*	✔	✔
	Diploastrea	*sp.*	✔	
	Favia	*sp.*	✔	
	Favites	*sp.*	✔	
	Goniastrea	*sp.*	✔	
	Leptastrea	*sp.*	✔	
	Leptoria	*sp.*	✔	
	Montastraea	*sp.*	✔	
	Platygyra	*sp.*	✔	
	Oulastrea	*crispata*	✔	✔
	Oulophyllia	*sp.*	✔	
Fungiidae	*Fungia*	*sp.*	✔	✔
	Podabacia	*sp.*	✔	
Merulinidae	*Hydnophora*	*sp.*	✔	✔
	Merulina	*sp.*	✔	
	Coelastrea	*aspera*		✔
	Coelastrea	*sp.*		✔
	Paragoniastrea	*deformis*		✔
Mussidae	*Symphyllia*	*sp.*	✔	✔
	Symphyllia	*radians*		✔
Oculinidae	*Galaxea*	*sp.*	✔	✔
Pectiniidae	*Echinophyllia*	*sp.*	✔	
Pocilloporidae	*Pocillopora*	*sp.*	✔	
Poritidae	*Alveopora*	*sp.*	✔	
	Goniopora	*cellulosa*	✔	✔
	Porites	*sp.*	✔	
	Porites	*murrayensis*		✔
Total number of species			**26**	**16**
Total number of genus			**26**	**13**
Total number of family			**11**	**9**

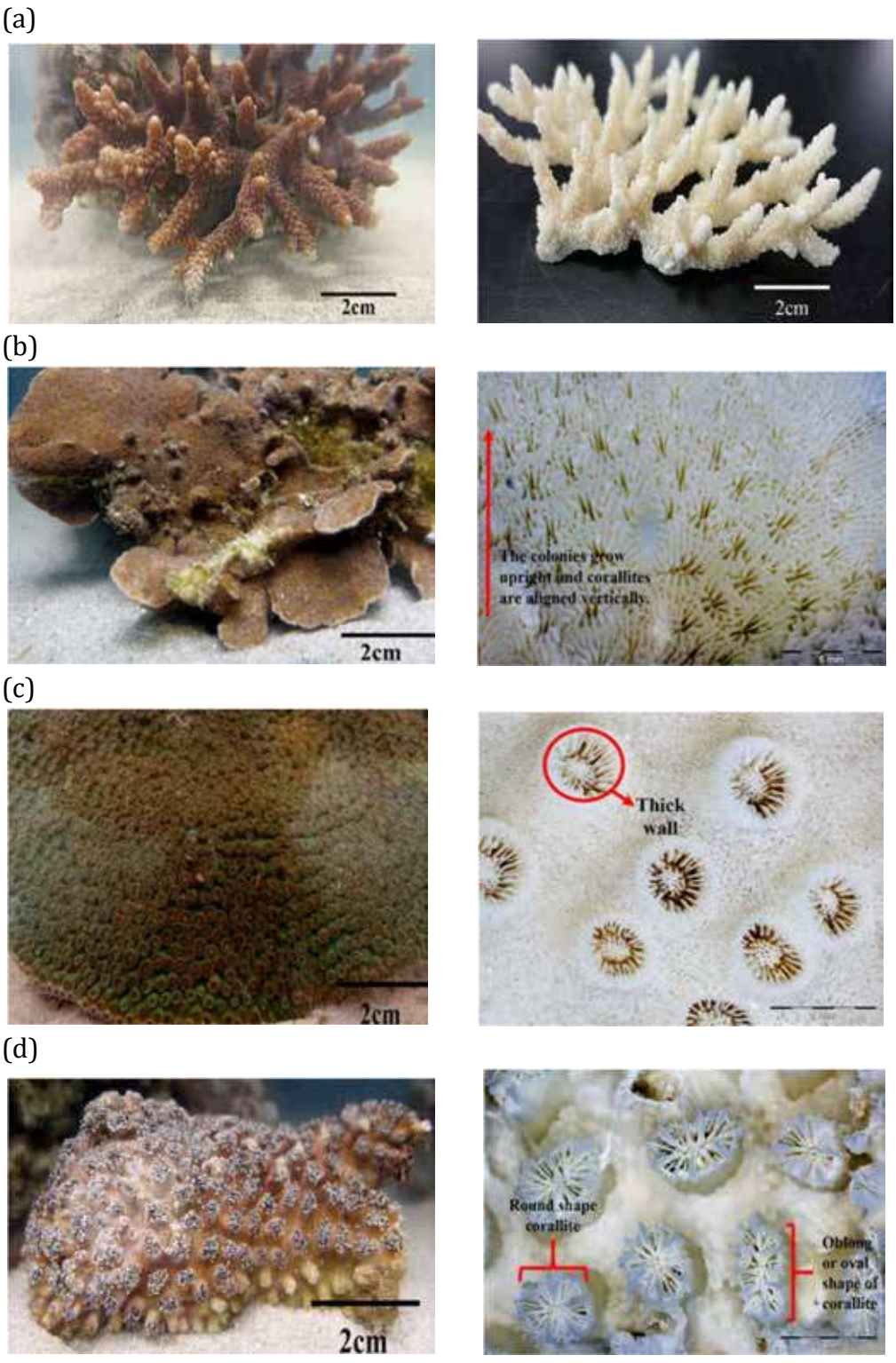

Figure 2.4.1. Underwater and skeletal images of the hard corals collected at Pulau Songsong; (a) *Acropora sp.,* (b) *Pavona danai,* (c) *Turbinaria sp.,* (d) *Galaxea sp.*.

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2.5 OCTOCORALS OF TUKUN TERENDAK, PULAU SONGSONG, KEDAH

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Abstract

Coral reefs in the northern region of the Straits of Malacca have a diverse group of octocorals growing on its bed. Collectively, not much is known about the octocorals found in the Straits of Malacca. The octocorals identified in this study are from Tukun Terendak, Pulau Songsong. This study was undertaken to identify and record the octocoral species found in the northern part of the Straits of Malacca.

Materials and Methods

Octocorals were surveyed and randomly collected with the aid of Self Contained Underwater Breathing Apparatus (SCUBA) diving in water one to ten meters deep along the coastline area of Pulau Songsong. Part of the samples were fragmented and preserved with 75% alcohol. The identification process for this research was conducted based on five important keys; the external form and colouration, polyps or colonial and fundamental structure of colonies, monomorphic, the arrangement of polyps, and the arrangement of sclerites.

Results and Discussion

In this study, six specimens were identified from three suborder, four families and six genera (Table 2.5.1). The specimens ranged from single stalk to huge sea fans.

Soft coral and gorgonian (sea fan) are species of animals grouped under the subclass Octocorallia. Their distinguish characteristic is their polyps which always bear eight tentacles (hence octocoral). All these octocoral species were found to be monomorphic coral type, where the polyp reproduces both asexually and sexually. The polyps with monomorphic, consisting of just autozooid polyps used for feeding purposes and sexual reproduction.

These six octocoral species could be categorized into three morphological types, namely unbranched colonies (*Viminella* sp., *J. juncea*), thin-branched colonies (*Echinogorgia* sp., *Astrogorgia* sp.), and branching fan-shaped (*Subergorgia* sp., *M. ochracea*). These different morphologies lead to identify the octocoral species into three suborder, they are Calcaxonia, Holaxonia and Scleraxonia.

In this study, octocorals were only found in rocky habitat, Tukun Terendak instead of coral reefs area, Pulau Songsong. The richest and most abundant sites is on submerged rocks in relatively strong currents. Furthermore, these octocoral species also able to survive under heavy sediment loads.

Table 2.5.1. List of octocorals found in Tukun Terendak, Pulau Songsong.

Sub-Class	Suborder (3)	Family (4)	Genus (6)	Species (6)	Descriptions	Image
Octocorallia	Calcaxonia	Ellisellidae	*Viminella*	*Viminella* sp.	**colour:** white, yellowish brown or red. **colony shape:** unbranched and whip-like. **polyp:** monomorphic, very contractile, but not retractile. **size:** 16.9cm tall	
			Junceella	*J. juncea*	**colour:** red, yellow or white. **colony shape:** unbranched and whip-like. **polyp:** monomorphic, contractile, but not retractile. **size:** 44.2cm tall	

Table 2.5.1. (Continue).

Octocorallia	Holaxonia	Plexauridae	*Echinogorgia*	*Echinogorgia* sp.	**colour:** red or yellow. **colony shape:** grow in single plane which forms thin branches. **polyp:** monomorphic. Retract into spiny calyces. **size:** 14.0cm tall	
			Astrogorgia	*Astrogorgia* sp.	**colour:** dark red, maroon. **colony shape:** open fan shaped, with irregular lateral branching. **polyp:** monomorphic, and retractile. **size:** 19.4cm tall	

Table 2.5.1. (Continue).

Octocorallia	Scleraxonia	Subergorgiidae	*Subergorgia*	*Subergorgia* sp.	**colour:** dark reddish brown. **colony shape:** lateral dichotomous branching, growing in a single plane. **polyp:** monomorphic. Retract into dome-shaped mounds. **size:** 25.0cm tall	
		Melithaeidae	*Melithaea*	*M. ochracea*	**colour:** reddish-orange. **colony shape:** branching fan-shaped. Grow in a single plane. **polyp:** monomorphic, small and retractile. **size:** 30.0cm tall	

Recommendations

In this study, octocoral samples were collected from northern part of Tukun Terendak. Octocorals found in seven to eight meters water depth. It is hypothesizing that deeper area of Tukun Terendak might have more density and diversity of octocorals. Therefore, it is recommended that more survey need to be done at deeper area of Tukun Terendak. Octocoral species found in this study are azooxanthellate (does not have symbiotic zooxanthellae in its tissue) and does not rely on light and photosynthesis to live.

2.6 PHOTOSYNTHETIC ACTIVITY OF CORALS IN PULAU SONGSONG, KEDAH

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Abstract

Effective and Maximum quantum yield is important in assessing the photosynthetic ability of corals. The change in corals' photosynthetic ability is a proxy of the current health status. The diving Pulse Amplitude Modulation (Diving-PAM) was used to measure the chlorophyll fluorescence of four species of scleractinian coral, namely *Porites lutea, Goniopora cellulosa, Cyphastrea chalcidicum* and *Pavona danai.* At present, there is lack of known data for the effective and maximum quantum photosynthetic yield of any scleractinian coral in Malaysian waters could use as indicator of Malaysian coral health. Thus, this study was aimed to evaluate the health status for four dominant scleractinian coral by assessing the quantum yield of the Photosystem II (PSII).

Materials and Methods

In this study, diving-PAM was used to measure the chlorophyll fluorescence of four dominant hard coral species of Pulau Songsong, which are *Porites lutea, Goniopora cellulosa, Cyphastrea chalcidicum* and *Pavona danai* (Figure 2.6.1). The measurements were further divided into effective quantam yield that is light adapted and maximum quantum yield, which is dark-adapted.

(a) Effective Quantum Yield (Light Adapted)

To obtain the effective quantum yield values, scleractinian corals maximum fluorescence (F_m) was measured using a saturating light pulse (0.8 s, <2000µmol quanta $m^{-2}s^{-1}$), and the changes in fluorescence ($\Delta F = F_m-F_o$) was then used to calculate effective quantum yield ($\Delta F/F_m$) for light-adapted corals. Each coral's quantum yield value is a mean value of three replicates. Statistical analysis was done using SPSS software and ANOVA test was conducted to determine the significant difference between sets of data.

(b) Maximum Quantum Yield (Dark-adapted)

For dark-adapted measurements, the effective quantum yield is the same as the maximum quantum yield ($F_m-F_o/F_m=F_v/F_m$). To obtain maximum quantum yield, the colonies needed to be dark-adapted for 30 minutes before taking the value. Each coral's value is a mean value of three replicates.

Results

In this study, the average (n=3) effective quantum yield value ($\Delta F/F_m$) of *G. cellulosa, P. lutea, C. chalcidicum* and *P. danai* were 0.688±0.030, 0.676±0.001, 0.672±0.003 and 0.730±0.006 respectively (ANOVA $p<0.05$) (Figure 2.6.2). The average (n=3) maximum quantum yield value (F_v/F_m) for these scleractinian corals was 0.707±0.003, 0.664±0.061, 0.634±0.032 and 0.593±0.236 respectively (ANOVA $p>0.05$). The yield value recorded is considered the first documented measurement for Pulau Songsong, Kedah.

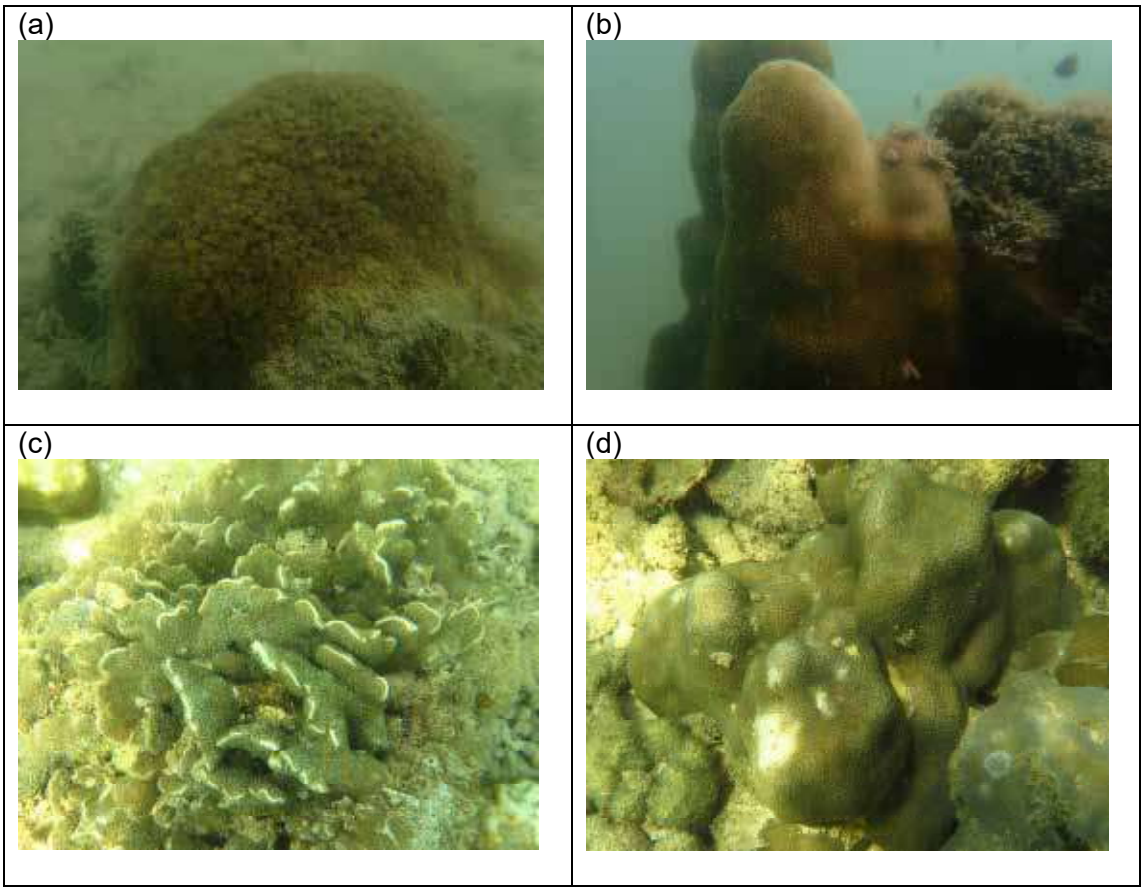

Figure 2.6.1. Hard coral species found in Pulau Songsong. (a) *Goniopora cellulosa;* (b) *Porites lutea;* (c) *Pavona danai;* (d) *Cyphastrea chalcidicum.*

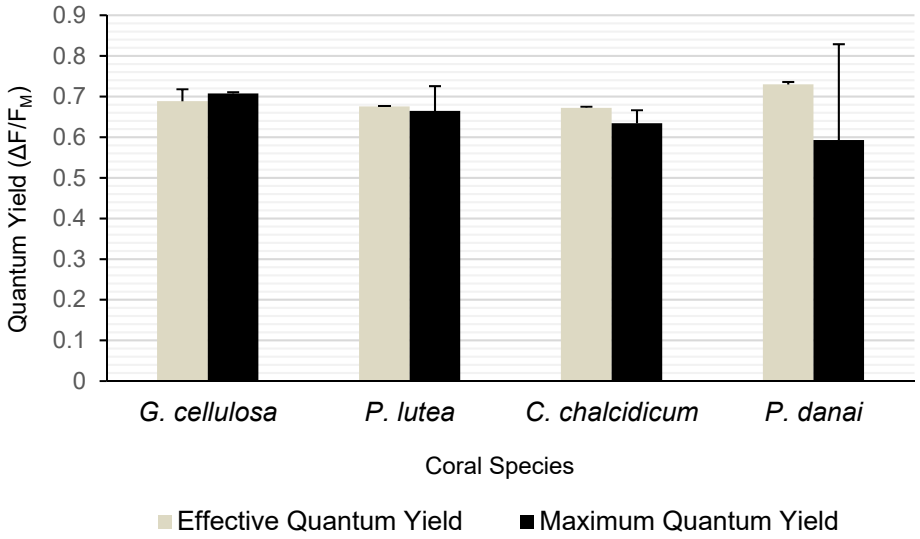

Figure 2.6.2. Differences between the effective quantum yield (light-adapted) ($\Delta F/F_m$) and maximum potential quantum yield (dark-adapted) (F_v/F_m) of corals in Pulau Songsong.

Discussion

This study presented the *in-situ* quantum yield of corals inhibiting turbid waters of Pulau Songsong. PAR value during sampling day was 891.5 µmol quanta $m^{-2}s^{-1}$. Even the light intensity was low, yield values recorded still considered higher as compared to the yield value reported for scleractinian corals from temperate region. This results also supported by a study done by Adzis *et al.*, (2009). Adzis *et al.*, (2009) also found that the quantum yield value of *Pocillopora damicornis* from Pulau Tioman, Malaysia is higher than Red Sea and Heron Island, Australia of the same species.

It is important to understand and know the yield value in healthy conditions. The reduction of both effective and maximum quantum yields indicated there is a stressful change in many environmental conditions (Flores-Ramirez & Linán-Cabello, 2007; Hill, Frankart & Ralph, 2004; Jones, 2004; Jones & Hoegh-Guldberg, 1999; Ralph, Larkum & Kühl, 2005).

Both values also used to assess stressful levels of introduced substances to the corals (Jones *et al.*, 1998; Cervino *et al.*, 2003; Jones *et al.*, 2000). Hence, the data from this study can be used as the indicator for photosynthetic capacity of scleractinian corals in comparison to assess the health of scleractinian corals in Malaysian waters.

Pavona danai showed significant difference among effective quantum yield value ($\Delta F/F_m$) of other three scleractinian corals (ANOVA $p<0.05$). The data set showed that *P. danai* is at its weakest photosynthetic compare to others. Plus, the thin-plate morphological structure of *P. danai* itself could cause this coral species to become a non-resilience coral type. Any further stress inflicted to *P. danai* could be more damaging.

Recommendations

Field observation during the expedition showed that local villagers frequently visit Pulau Songsong for recreational activities such as picnic, snorkelling and fishing. These activities could contribute to the increase of damaged corals. Consequently, it became the main factor contributing to the decline of coral coverage at Pulau Songsong. From this study, it is suggested that a proper management plan on tourist activities at sensitive reef areas is needed to minimise the stress and damage.

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2.7 OCCURRENCE OF *Ceratium furca* BLOOM ON THE COASTAL WATERS OF PULAU SONGSONG, KEDAH

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Introduction

Harmful Algal Blooms (HABs) or commonly known as "red tides" happens due to the changes of environmental conditions. HABs cause huge economic loss for human such as aquaculture activities, fishing and tourism. Typically, during bloom events only one or a few phytoplankton species are involved, and some blooms may be recognized by discoloration of the water resulting from the high density of pigmented cells. According to Naqqiuddin *et al.* (2014), there are several factors that contribute to HABs such as changes in temperature, salinity, light intensity, water current, weather changes and nutrient supply. During the H2O Songsong-Jerai Expedition, which was jointly conducted by Departmenent of Marine Park Malaysia and CEMACS, Universiti Sains Malaysia, researchers detected the "Red tides" phenomena in the coastal area of Pulau Songsong.

Methods and Materials

Pulau Songsong, which is located in the Northern Straits of Malacca, is a popular area for boating and tourism activities. During the algae bloom occurrence, surface water was collected with two 500 ml bottle from a boat. These samples were brought back to the laboratory, fixed with Lugol solution and stored at room temperature until the observation using light microscope. Phytoplankton cell densities were recorded, and identification was done until genus level.

Results and Discussion

Photo images from the light microscopes of the large-celled species of dinoflagellates are shown in Figure 2.7.1. The dinoflagellates present in the samples were identified as *Ceratium furca* (Order: Gonyaulacales, Family: Ceritiaceae). The upper body of the observed cell was long and narrow, and formed an apical horn. It became gradually thicker towards the base, where it formed an epitheca. Cell density of the samples observes during the bloom were 1,960,000 cell/L. Results indicated that *Ceratium furca* comprises over 95% of the total samples collected. *Ceratium furca* are mainly coastal species, but can also be found in open oceans and in estuaries (Horner, 2002).

Activities in coastal areas such as agriculture and sewage release from Merbok River to the sea could cause nutrient imbalance that may increase the chances of the bloom. The high nutrient discharge associated with this river will enhance the biological activity in the sea (Smayda, 2002). Dinoflagellates, which can swim and are able to take in nutrients efficiently, can form a bloom by growing in the niche vacated by the diatoms. The genus *Ceratium* has been classified into surface distribution species (surface species) and deep layer distribution species (shade species) in a water column.

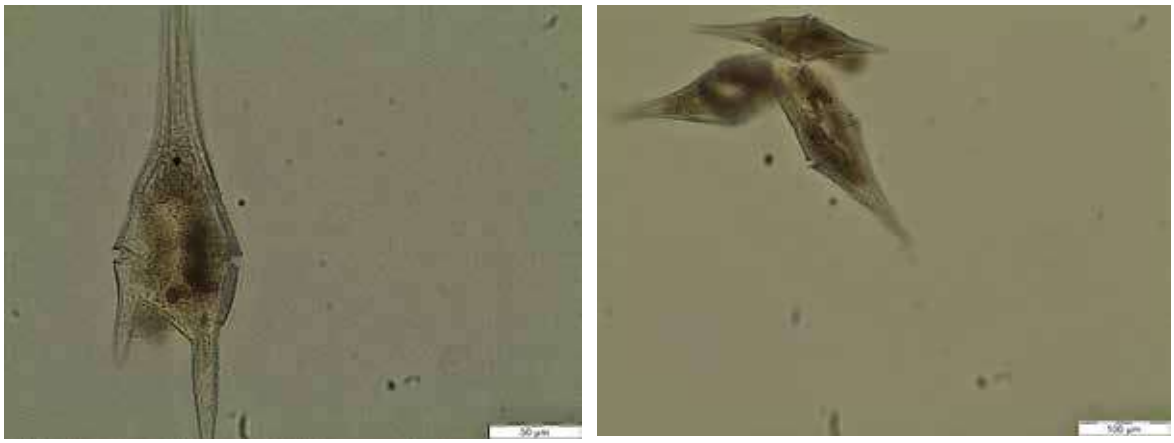

Figure 2.7.1. Microphotographs of the large dinoflagellate, which was identified as *Ceratium furca*

Recommendations

To understand the causes and possible occurrence of algal bloom, frequent monitoring of nutrients levels along the coastal areas and river discharge is crucial. Increases in nutrient levels (mainly phosphorus and nitrates) from fertilizer run-off from residences and agricultural lands, sewage discharges, and run-off from urban areas and industrial facilities could cause rapid growth in marine phytoplankton. Proper legislative and policy changes are needed to control sewage or waste discharges, since it has the potential to prevent certain types of HABs (Okaichi, 1997). Apart from field monitoring, scientists have demonstrated that satellite imagery can also be used to track the frequency of harmful algal blooms. Hence, further studies in regard to these technologies are needed in our waters.

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2.8 MARINE MAMMALS IN NORTHWESTERN PENINSULAR MALAYSIA

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Introduction

The waters of northwestern peninsular Malaysia consist of the islands of Langkawi, the coastline of Kedah and Penang. Recently, marine mammal research in this region has become more intensive following the discovery of various inshore species of cetaceans and whales. In particular the areas of Penang, Matang and Langkawi are currently being studied for their dolphin populations in western peninsular Malaysia. As of 2012, there are 27 species of marine mammals including one Sirenian the dugong (*Dugong dugon*) confirmed in both peninsular and East Malaysia. (Jaaman, 2006; Ponnampalam, 2012).

The key species that have been studied in peninsular Malaysia include the Indo Pacific humpback dolphin (*Sousa chinensis*), Irrawaddy dolphin (*Orcaella brevirostris*), and Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) (Nadarajah, 2000; Jaaman, 2006; Minton *et al.*, 2011; Ponnampalam, 2012; Rajamani, 2014; Rajamani *et al.*, 2014; Rajamani, 2015; Rodriguez, 2015). The coastal areas of northwest peninsular Malaysia, especially Penang and Langkawi, Kedah are rapidly developing with tourism being a large focus for economic growth (Marzuki, 2011; Chee *et al.*, 2017). However the other parts of Kedah represents tourism at a slower pace (Liu, 2006). Rapid coastal development is set to continue in Penang and Langkawi without an understanding of the numbers and types of marine mammals found in these regions. This increase in development in these regions could significantly alter the islands's coastline affecting inshore dolphin species such as the Irrawaddy dolphin, Indo-pacific humpback dolphin and Finless porpoise, which reside there. Thus marine mammal populations are potentially at risk even before they are discovered with population distribution and numbers not known. The purpose of this paper is to learn of the current knowledge of marine mammals found in northwestern peninsular Malaysia.

Materials and Methods

The main study site of the expedition (Biodiversity expedition H2O Songsong-Jerai, Kedah) was Pulau Songsong where there have been no previous reports of cetaceans. A desk top survey was conducted to provide a review of marine mammal research done in northwest peninsular Malaysia, an area which includes Pulau Songsong north of Penang located at Yan, Kedah. Any opportunistic sightings of dolphins were also recorded from 27th to 29th of September 2017 during the Songsong-Jerai expedition.

Results

During the Pulau Songsong expedition, one sighting of an unidentified dolphin was made close to the mouth of Sungai Merbok river, presumably an Irrawaddy dolphin (N 05^{o}41'20.2" E100^{o}16'48.9"). Preliminary interviews indicate that Irrawaddy dolphins are found at river mouths in Kedah.

A few sporadic studies have been conducted on marine mammals in peninsular Malaysia. In peninsular Malaysia the first most widespread survey was conducted by WWF-Malaysia in 2000.Five study sites throughout peninsular Malaysia were investigated for the presence of marine mammals out of which three included the Melaka coastline, Perak state coastline

and Langkawi archipelago Currently, there are nine species said to located in north west peninsular Malaysia (Table 2.8.1). These include the Irrawaddy dolphin (*Orcaella brevirostris*), Indo-Pacific finless porpoise (*Neophocaena phocaenoides*), Indo Pacific humpback dolphin (*Sousa chinensis*), Indo Pacific bottlenose dolphin (*Tursiops aduncus*), Melon Headed Whale (*Peponocephala electra*), Pan tropical spotted dolphin (*Stenella attenuata*), Striped dolphin (*Stenella coeruleoalba*), False killer whale (*Pseudorca crassidens*), and Brydes whale (*Balaenoptera edeni*) (Nadarajah, 2000; Ponnampalam, 2012; Rajamani, 2014 and 2015; Rodriguez, 2015; Rajamani *et al*., 2018).

Table 2.8.1. Checklist of species found in northwest peninsular Malaysia based on location.

Location	Species Found	Reference
Langkawi Island	Irrawaddy Dolphin (*Orcaella brevirostris)* Indo Pacific Finless Porpoise *(Neophocoaena phocaeoides)* Indo-Pacific Humpback Dolphin (*Sousa chinensis*) Pantropical Spotted Dolphin (*Stenella attenuate)* False Killer Whale (*Pseudorca crassidens)* Bryde's Whale (*Balaenoptera edeni)* Bottlenose dolphin (*Tursiops truncatus*)	Nadarajah, 2000; Ponnampalam & Jamal Hisne, 2011; Ponnampalam, 2012.
Kedah	Irrawaddy Dolphin (*Orcaella brevirostris)* Melon-headed Whale (*Peponocephala electra)* Striped dolphin *(Stenella coeruleoalba)* Bryde's Whale(*Balaenoptera edeni)*	Nadarajah, 2000; Ponnampalam, 2012.
Penang	Irrawaddy Dolphin (*Orcaella brevirostris)* Indo Pacific Finless Porpoise *(Neophocoaena phocaeoides)* Indo-Pacific Humpback Dolphin *(Sousa chinensis)* Indo-pacific Bottlenose Dolphin *(Tursiops aduncus)*	Rajamani, 2015; Rodriguez Vargas, 2015; Rajamani *et al.,* 2018.
Perak Island	Bryde's Whale(*Balaenoptera edeni)*	Ponnampalam, 2012

The most common species found in this region is the Indo-Pacific humpback dolphin, Irrawaddy dolphin and Indo-Pacific finless porpoise, which have been reported in both Langkawi and Penang (Nadarajah, 2000; Jaaman, 2006; Minton *et al*., 2011; Ponnampalam, 2012; Rajamani, 2014; Rajamani *et al*., 2014; Rajamani, 2015; Rodriguez, 2015). The limited information available on the other species in northwest peninsular Malaysia is also discussed.

i. Indo-Pacific humpback dolphin (*Sousa chinensis*)

Recent research on humpback dolphins has been conducted in Langkawi Island and Penang Island (Ponnampalam & Jamal Hisne, 2011; Rajamani, 2015). In the year 2000, two sightings of Indo Pacific humpback dolphin were made by Nadarajah (2000). One sighting on the west coast of Langkawi was that of a single dolphin whereas the other sighting in the north of Langkawi was of a mixed group of humpback and bottlenose dolphins, totalling between 60 to 70 animals. In 2011, Indo-Pacific humpback dolphins were also sighted during Ponnampalam and Jamal Hisne's more comprehensive survey in Langkawi. Most sightings of the Indo-Pacific humpback dolphin were from 1 to 9 individuals and in depths no greater than 18 m (Figure 2.7.1). A group of 100 Indo-Pacific humpback dolphins were seen on the west of Langkawi (Ponnampalam & Jamal Hisne, 2011). To date 102 individuals of the Indo-Pacific humpback dolphins have been identified in the photo identification database based on the left dorsal fin while 53 individuals have been identified by the right dorsal fin (Ponnampalam & Jamal Hisne, 2011).

An acoustic study comparing the whistles of the Indo-pacific humpback dolphin (*Sousa chinensis*) from two areas of western Peninsular Malaysia (Hoffman *et al.*, 2015) in Matang and Langkawi was conducted. It was found that there were significant multivariate differences were found between dolphins of two locations in their whistle duration, frequency modulation and all frequency variables except for minimum frequency (Hoffman *et al.*, 2015). The differences in whistles may be due to adaptations to local acoustic habitat or unique whistles that may have developed due to social interactions within each location, or broader scale differences resulting from geographic separation between the locations (Hoffman *et al.*, 2015).

Since October 2012, twelve sightings of Indo-Pacific Humpback dolphins were recorded in the waters of Penang National Park. The nine groups (n=9) of two to 30 individuals (mean group size of 12 ± 4) were spotted travelling from the northwest to the west of the Island (Rajamani *et al*., 2018). In some occasions it was possible to follow the group from Teluk Bahang all the way to Pantai Kerachut, which is approximately 9 km away. The groups were mainly travelling, and displaying other movements like flapping with their tails, and leaping with their full body out of the water. On occasions some groups travelled at lower speeds to feed in areas such as Teluk Aling, and Teluk Duyung (Monkey Beach) (Rodriguez-Vargas & Rajamani, 2014). Four stranding of this species were also reported (Rajamani *at al*., 2018). As a result of these and other surveys, sufficient data was provided to identify at least 44 individuals, 28 individuals were identified from left dorsal fin and 30 individuals identified from the right dorsal fin.

In August 2014, line transect surveys were conducted in Penang and three sightings of Indo Pacific humpback dolphins were made in north and south Penang (Rajamani *et al*., 2018). In all three sightings they were observed feeding. The first and second sightings were in northwest Penang near Teluk Aling and the third sighting was in the southern western part of the island 30 km from the first sightings. It consisted of a larger group of about 50 dolphins feeding in the shallow waters less than 1 km of the south-western tip of Penang island. The group was followed for more than two hours with the dolphins moving northward covering 8 km. It was observed that as the dolphins travelled north they dispersed into smaller groups, some swimming close to shore, others were moving offshore. There were some calves observed travelling close with adults presumably to be with their mothers (Rajamani & Dolar, 2018).

ii. Irrawaddy dolphin (*Orcaella brevirostris*)

The Irrawaddy dolphin has been sighted in Penang and Langkawi (Figure 2.8.1) (Ponnampalam & Jamal Hisne, 2011; Rajamani, 2014 and 2015; Rodriguez-Vargas, 2015; Rajamani *at al.*, 2018). In Langkawi, one Irrawaddy dolphin was sighted in November 2010 (Ponnampalam and Jamal Hisne, 2011). In Penang, there were numerous sightings and based on interviews in Sungai Pinang, there have been sightings of Irrawaddy dolphin in western Penang (Rajamani *et al.*, 2014). It is also probable that that the Irrawaddy dolphin was the species spotted in the river mouth of Sungai Merbok north of Penang and south of Song-Song island.

In 2013, 44 boat surveys were conducted with six in northwest and 38 in west Penang, which was the focus area. The total effort was 194 hours and 39 minutes, with a daily mean of 4.42 ± 0.19 hours. The total distance travelled was 1009.8 km. During the 38 days of survey in West Penang, 43 sightings of *Orcaella brevirostris* were recorded with a rate of encounter of 0.25 sightings per hour, and 1.13 sightings per day. Dolphins were recorded in 66% (n=25) of the surveys. Initial estimates of population size based on mark-recapture analysis reveal that the population was between 32 to 51 animals. A photo-identification catalogue has been developed with 30 identified dolphins. The discovery curve indicates a distinct upward shift indicating that there are more animals to be discovered (Rodriguez-Vargas, 2015).

iii. Indo-Pacific finless porpoise (*Neophocaena phocaenoides*)

The finless porpoise has been observed in both Penang and Langkawi (Figure 2.8.1) (Ponnampalam & Jamal Hisne, 2011; Rajamani, 2014; Rajamani *et al.*, 2014; Rajamani, 2015; Rodriguez-Vargas, 2015; Rajamani *at al.*, 2018). In Langkawi, it was the most frequently encountered and was sighted during all surveys around the island and also in waters close to the mainland (Ponnampalam & Jamal Hisne, 2011). They were found in very shallow depths of less than 5 m as well as in deeper waters greater than 40 m. Finless porpoise groups that were encountered contained a mean of 4.2 individuals however some larger groups of 16 were also observed (Ponnampalam & Jamal Hisne, 2011).

On September 25th 2013, Finless porpoises (*Neophocaena phocaenoides*) were sighted for the first time during dedicated boat surveys in West Penang (Sungai Pinang) searching for Irrawaddy dolphins (Figure 2.7.1). A total of eighteen sightings were recorded since then, with observations of groups between one to seven individuals and a mean group size of 3.67 ± 0.43 SE individuals. The sightings were recorded in waters between 2.6 and 9.1 m deep, with a mean depth of 5.22 ± 0.47 SE. On November 15th 2013, a group of at least seven finless porpoises was observed highly active in what seemed to be a socializing and feeding activity also in West Penang. Individuals were swimming synchronously close to each other, jumping, and rubbing against one another (Rodriguez-Vargas, 2015). These results confirm the presence of the finless porpoise (*Neophocaena phocaenoides*) in Penang.

iv. Indo Pacific bottlenose dolphin (Tursiops aduncus)

The bottlenose dolphin has been observed previously in southern Penang and Sarawak (Nadarajah, 2000; Jaaman *et al.*, 2001; Jaaman, 2004; Bali *et al.*, 2008; Ponnampalam *et al.*, 2012). In Penang, Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) was positively identified from images provided by the Department of Fisheries and sighting on two occasions in northern Penang waters where the dolphins is calling of were attempting to strand. One stranding of a dead bottlenose dolphin was also reported at Pantai Kerachut (Rodriguez-Vargas & Rajamani 2014).

v. Other Species of Marine Mammals

a. Melon headed whale (*Peponocephala electra*): the only confirmed record on the melon headed whale West Malaysia is from a stranding record in April 1999 in Kedah (Nadarajah, 2000).

b. Bryde's whale (*Balaenoptera edeni*): recent research indicates the Bryde's whale was found in Langkawi (Ponnampalam and Jamal Hisne, 2011). Two sightings were reported in 2011, one of which was a mother and calf pair (Ponnampalam & Jamal Hisne, 2011).

c. False Killer Whale (*Pseudorca crassidens*): skeletal remains of one skull of a false killer whale were found on Dayang Bunting Island in Langkawi is a decorative piece in a beach bar in Pantai Cenang (Nadarajah, 2000).

d. Pantropical spotted Dolphin (*Stenella attenuata*) and **Striped Dolphin** (*Stenella coeruleoalba*): these pelagic species were found to occur in Langkawi (Ponnampalam, 2012)

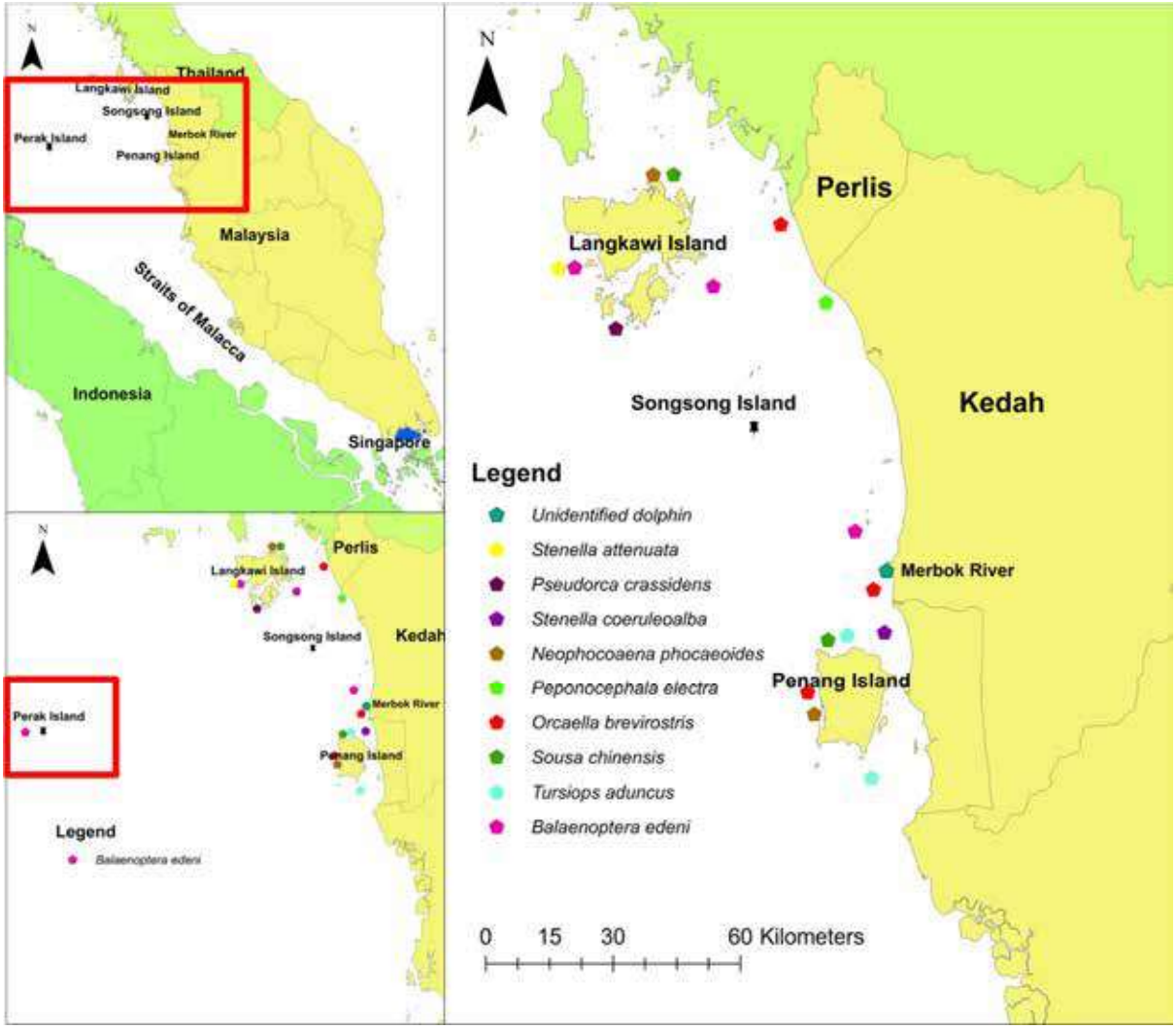

Figure 2.8.1. Distribution of marine mammals in northwest peninsular Malaysia (Ponnampalam & Jamal Hisne, 2011; Ponnampalam, 2012; Rajamani, 2014; Rajamani *et al.*, 2014; Rajamani, 2015; Rodriguez, 2015)

Discussion

Based on the compilation of previous research it appears that there are three main species most commonly found in the region, which includes the Humpback dolphin, Irrawaddy dolphin and Finless porpoise. It appears that there are significant populations of these species in this region, which needs further investigation. A better understanding of the population size of each species is needed as well as distribution and movements of these animals. In Penang and Langkawi, the humpback dolphins appear highly mobile moving rapidly from one part of the island to another in a matter of hours.

In Penang Irrawaddy dolphins appear residential in the Western part of Penang although there may be still a lot of movements in and out of the population. Therefore it would be interesting to study the ranging patterns of these two species. It would be also important to investigate if there are population of the dolphin at estuaries in Penang, Langkawi and Kedah. Very little information is known about the population size of the finless porpoise. The Irrawaddy dolphin, Humpback and Finless porpoise are classified as Vulnerable, Endangered and Vulnerable respectively under the IUCN Red List of Endangered Species (The IUCN Red List of Threatened Species, 2018,). These inshore species are vulnerable to threats such as loss of habitat, which includes estuarine environments, coastal bays and lagoons and mangroves. They are also vulnerable to incidental entanglement in nets especially gill nets (Jefferson *et al.*, 2017; Minton *et al.*, 2017; Wang & Reeves, 2017). Penang and Langkawi are regions where rapid development is a main focus, so it is imperative that information is obtained so that appropriate conservation and management plans for cetaceans can be implemented. Adaptive management would be the way forward as new data on these dolphins is obtained.

Recommendations

It is recommended that line transects be conducted from Langkawi to Penang to get a better idea of the abundance and distribution of cetacean populations in the region. It would be also important to investigate the dolphins found to Merbok River mouth, which are probably Irrawaddy dolphins. Photo-identification studies can then be conducted in this area. Information on population size, site fidelity, habitat use and range would provide valuable information to inform management of the species. Since there are also whale species, the line transect surveys will provide a better understanding of the status of these whales, which may be transients or cross boundary migratory species.

Acknowledgements

I would like to thank our funders the Department of Marine Park, Malaysia for us to go on the Song Song expedition. I would also like to thank Dr.Azimah Abd Rahman for preparing the GIS map for this scientific paper. Special thanks to the staffs of CEMACS for assisting me in the logistics where possible.

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2.9 FISHES OF PULAU SONGSONG, KEDAH

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Abstract

Fish inventory of Pulau Songsong was conducted on the 28th and 29th October 2017 using rods and lines. There were five anglers for both days, each with one to two rods or lines. Baits used include fish flesh and squids. Targeted fish include pelagic, demersal and coral fishes. Fishing spots were scattered around the island within 80 m from the shore. Due to bad weather, fishing duration on the 29th was cut short to 3 hours compared to 6 hours on the 28th. Due to similar reason, fishing at Tukun Terendak was annulled. Fifty individuals comprised of 16 species were captured during the two days. Catch per unit effort (CPUE) was 0.55/person/hour with total weight of 9.35 kg. The largest fish captured was *Pomadasys kaakan* (javelin grunter @ gerut-gerut ompakan) with 1.8 kg followed by *Epinephelus coioides* (orange spotted grouper @ kerapu bitnik jingga) with 1.74 kg. The most captured species was *Cephalopholis boeneck* (chocolate hind @ kerapu belang perang) with nine individuals, followed by *Scolopsis vosmeri* (white cheek monocle bream @ pasir- pasir pipi putih) and *Nemipterus hexodon* (ornate threadfin bream @ kerisi pelangi), each with six individuals. Among the 16 species, two species are yet to be identified. This fish inventory is incomplete due to time and financial constraints. Nonetheless, the list may serve as baseline data for future reference and species addition. For future studies, different sampling gears and monsoon and tidal influences, shall be included to acquire a firm result.

Introduction

Ocean accommodates a huge number of marine organisms. Among the organisms, ichthyofauna is the most diverse group of life on earth that had been evolved (Kar *et al.*, 2006; Levêque *et al.*, 2008). Fishes constitute more than half of all vertebrates and over half of them are marine fishes (Eschmeyer *et al.*, 2010). According to FishBase, 32,700 species of fish worldwide had been described until August 2013. The Catalog of Fishes stated that 100 to 150 new marine species are being described each year. Marine fish is diverse because the ocean covers 70% of Earth's surface.

Coral reef fishes serve as an indicator for marine ecosystem based on the distribution pattern (Allen, 2008). Coral reefs support high diversity of fish (Chabanet *et al.*, 1997) and have strong correlation between other organisms' diversity such as molluscs and corals. In fact, coral reef provides diversity of the entire marine ecosystem (Briggs, 1974). Pulau Songsong, which is not a marine protected area is surrounded by corals, and thus serve as nursery and safe for coral fishes. Due to the unprotected status, this island is also susceptible to fishing activities. The objective of this study is to acquire fish species inventory for management purpose.

Materials and Methods

The methodological approach adopted is comprised of several capturing methods (Ambak et al., 2010 and 2012). During this expedition, most of the fish specimens were collected using rod and line fishing.

Results

Fifty individuals comprised of 16 species were captured during the two days (Table 2.9.1 and Figure 2.9.1). Catch per unit effort (CPUE) was 0.55/person/hour with total weight of 9.35 kg. The largest fish captured was *Pomadasys kaakan* (javelin grunter @ gerut-gerut ompakan) with 1.8 kg followed by *Epinephelus coioides* (orange spotted grouper @ kerapu bitnik jingga) with 1.74 kg. The most captured species was *Cephalopholis boeneck* (chocolate hind @ kerapu belang perang) with nine individuals, followed by *Scolopsis vosmeri* (white cheek monocle bream @ pasir-pasir pipi putih) and *Nemipterus hexodon* (ornate threadfin bream @ kerisi pelangi), each with six individuals. Among the 16 species, two species are yet to be identified.

Table 2.9.1. List of captured and identified fish species at Pulau Songsong from 28th and 29th October 2017 using rods and lines.

#	Family	Species	English/Local
1	Echeneidae	*Echeneis* spp.	tapak kasut
2	Haemulidae	*Pomadasys kaakan*	gerut-gerut ompakan
3	Lutjanidae	*Lutjanus vitta*	kunyit remong
4	Nemipteridae	*Nemipterus hexodon*	kerisi pelangi
5	Nemipteridar	*Scolopsis vosmeri*	pasir-pasir pipi putih
6	Platycephalidae	*Inegocia japonica*	baji jepun
7	Pomacentridae	*Abudefduf bengalensis*	gombing benggala
8	Rachycentridae	*Nibea soldado*	gelama papan
9	Sciaenidae	*Dendrophysa russelii*	gelama janggut tanda
10	Sciaenidae	*Otolithes ruber*	gelama tengkerang
11	Serranidae	*Cephalopholis boeneck*	kerapu belang perang
12	Serranidae	*Cephalopholis formosa*	kerapu garis biru
13	Serranidae	*Epinephelus coiodes*	kerapu bintik jingga
14	Serranidae	*Epinephelus sexfasciatus*	kerapu bebeh

Discussion

Marine habitat provides an extensive variety of food supply and shelter from predators. Each habitat is specific to a certain population. The coral reef habitat influences the fish assemblage structure (Friedlander & Parrish, 1998). Different marine habitats have different organisms subject to their adaptations to the habitat.

In marine and especially coral ecosystem, habitat destruction due to anthropogenic activities is a main threat to the marine organisms (Claudet & Fraschetti, 2010). Habitat change, which may cause by the destructive fishing, overfishing, aquaculture, the introduction of invasive species, organic enrichment, offshore development and climate change, could interrupt to the food web complexity, distribution range, changing of habitat structure and the loss of native species in a certain area (Parmesan & Yohe, 2003). The habitat destruction will affect the diversity, structure and function of an ecosystem. Therefore, the productivity of the marine surrounding will be decrease (Newton *et al.*, 2007). The habitat loss is identified by the loss of resident species, loss of the food resources and loss of the ecosystem function and properties related to the influence of the habitat on the environment (Airoldi *et al.*, 2008).

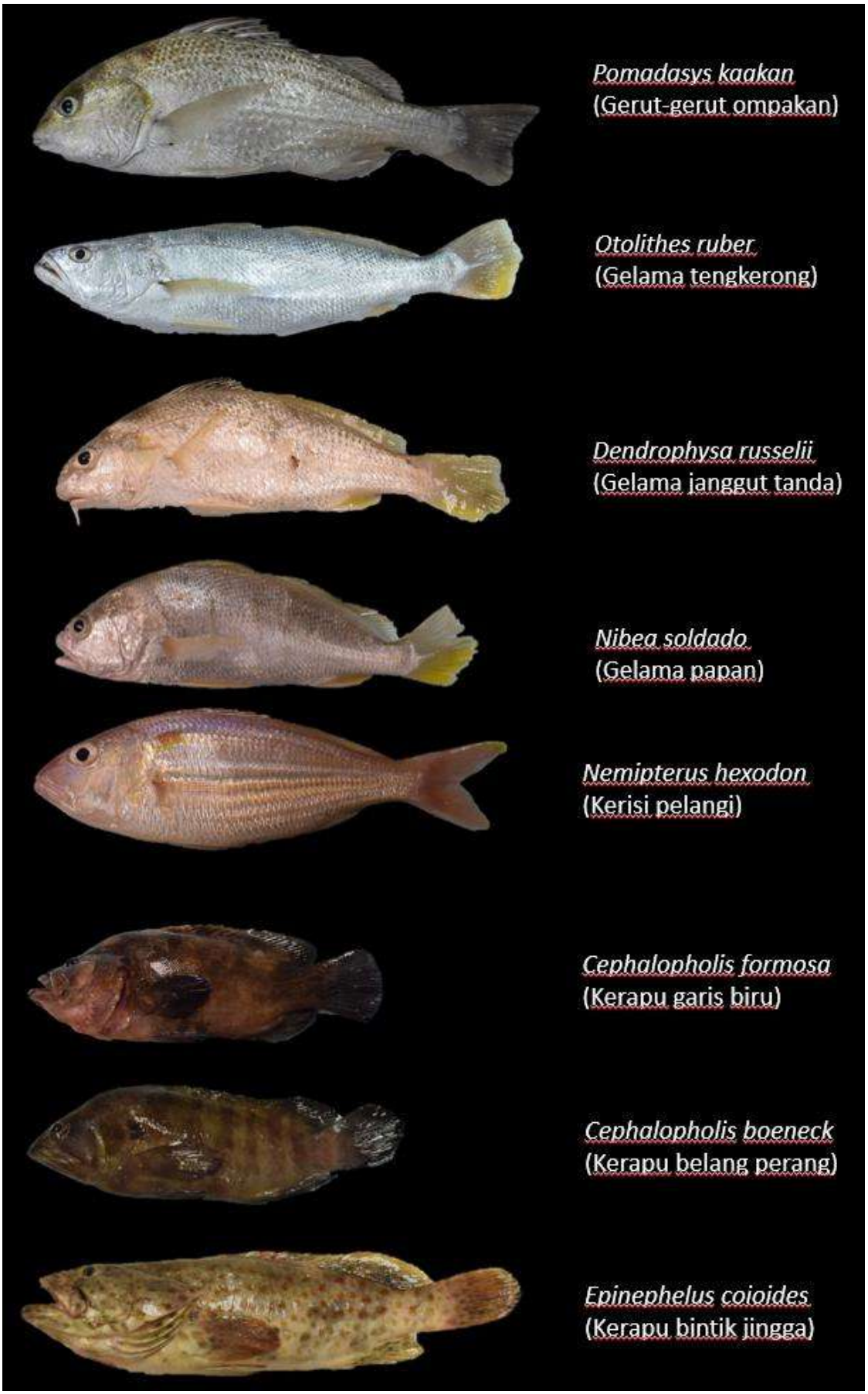

Figure 2.9.1. The images of captured and identified fish species of Pulau Songsong.

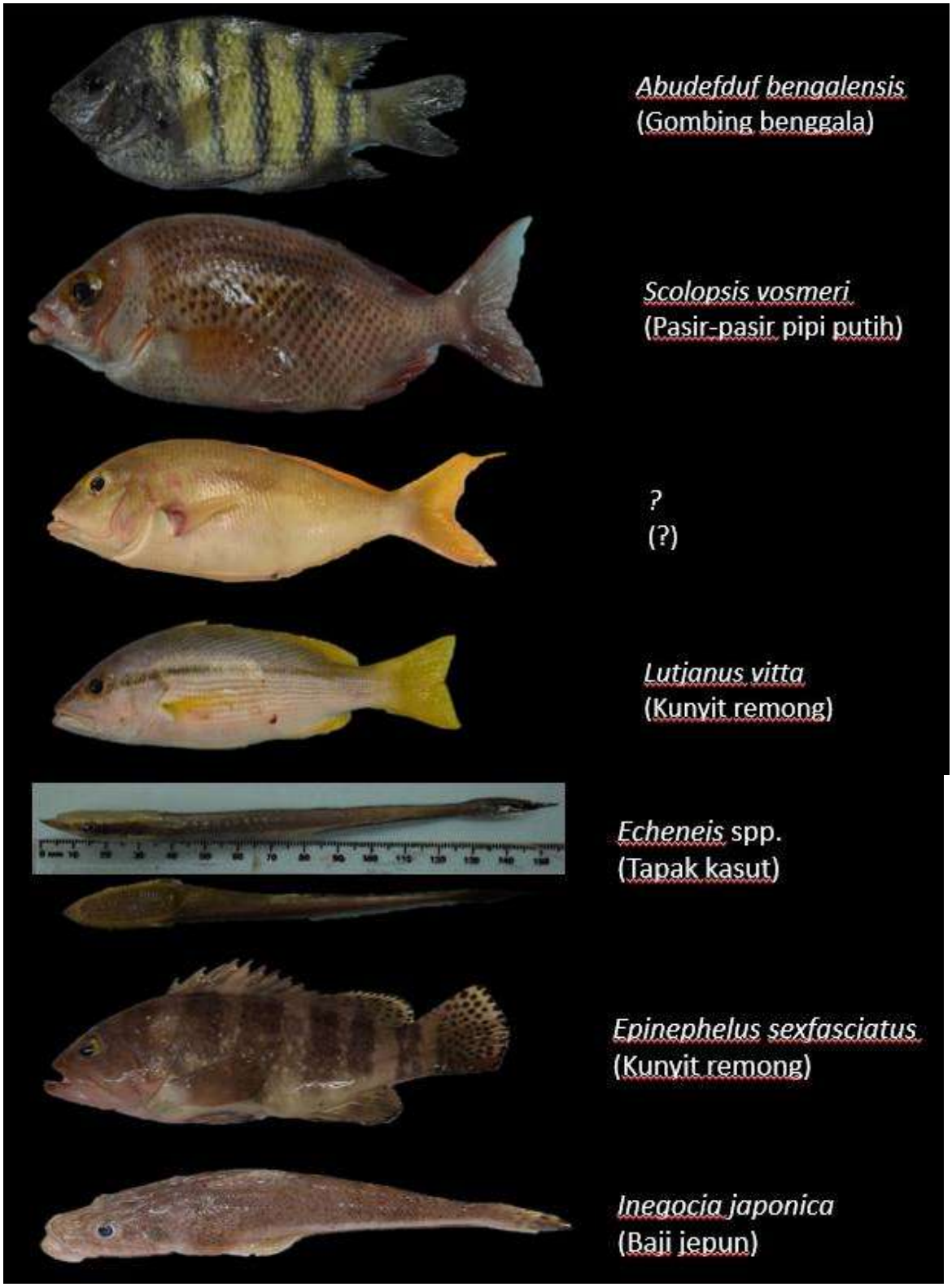

Figure 2.9.1. (Continue).

Recommendations

Based on the captured fishes, a lot of information regarding fish stock, condition, abundance, recruitment and etc., cannot be acquired due to insufficient sample size. Perhaps, more advanced studies shall be included in the future using multiple fishing gears including underwater survey. On the other hand, the importance of these data to fisheries management of Pulau Songsong should be evaluated, as the cost may not be economical. Nonetheless, as an ecologist, and due to the island's open status, the above-mentioned data shall be acquired and analysed for long-term sustainable fishing and management.

Acknowledgements

We would like to thank the Department of Marine Parks Malaysia for the funding for the expedition, project leader Prof. Dato' Aileen Tan Shau Hwai for inviting the fish group, expedition leader, Prof. Zulfigar Yasin and his group of students for logistic arrangements and School of Biological Sciences for their support staffs and facilities.

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2.10 THE FLORA OF PULAU SONGSONG, PULAU BIDAN, PULAU TELUR AND GUNUNG JERAI, KEDAH

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Abstract

The flora survey for H2O Songsong-Jerai Expedition in September 2017 covered both the coastal hill forest and montane forest. A total of 108 herbarium collections of flowering and fruiting plants, which included about 55 families, 67 genera and 102 species, was collected. The most abundant families were Leguminosae and Rubiaceae. A few of interesting plants collected included endemic species, *Begonia sibthorpioides* Ridl. and a new record species to Gunung Jerai, *Fagraea splendens* Blume. A glimpse of flowering and fruiting plants encountered during the expedition is presented and illustrated.

Introduction

Pulau Songsong, Pulau Bidan and Pulau Telur are coastal islands, commonly referred as the Songsong group of islands, located in the northern region of the Straits of Malacca. Meanwhile Gunung Jerai is the mountain opposite the Songsong group of islands. Botanical information for the Songsong group of islands is very limited contrary to Gunung Jerai which has been extensively collected since 1900's. Thus, the main objective for this expedition was to make a general collection of flowering and fruiting plants.

This expedition initially made for promoting the biodiversity of Pulau Songsong, Pulau Bidan and Pulau Telur, three islands aligned close to each other and clearly visible from Pantai Murni, Yan, Kedah. These islands consist of sandstone and Kawi stone elements and produce an aesthetic view for visitors with red brick-like stones.

Materials and Methods

Botany team from Forest Research Institute Malaysia Herbarium (KEP) joined the 4-day H2O Songsong-Jerai Expedition (28 September - 1 October 2017) that concentrated at Pulau Songsong, Pulau Bidan, Pulau Telur and Gunung Jerai. This paper provides highlights of some of the interesting flowering plants. The flora surveys were carried out along the following trails: (Table 2.10.1):

Table 2.10.1. Dates and locations of the trail.

Date	Trail
28 September 2017	Pulau Songsong
29 September 2017	Pulau Bidan
30 September 2017	Top of Gunung Jerai
1 October 2017	Pulau Songsong and Pulau Telur

Collections were made of fertile vascular plants for herbarium specimens. Specimens are deposited in the Forest Research Institute Malaysia Herbarium (KEP) and recorded in the Botanical Research and Herbarium Management System (BRAHMS) database.

Results

(i) Vegetation Types

Pulau Songsong and the neighbouring islands are lowland forest on different types of terrain including ridges and coastal areas. The botanical collecting initially made for Pulau Songsong, which is the biggest among the three islands with the highest point up to 118 m above sea level. Most of the island is rocky with only one sandy beach facing the mainland, Pantai Murni, Yan. The forest area is disturbed as the island had previously been used for an army camp. On the north side of the island, the rocks easily fall and are very unstable to step on. We also found a damaged stairway at the base of the hill, which was probably used for climbing up.

Pulau Telur situated between Pulau Songsong and Pulau Bidan is the smallest island, with the highest point approximately 68 m above sea level. This island consists of rocky boulders with sparse vegetation. There is only one sandy beach on the east side of the island, while the rest is mostly steep cliffs.

Finally, the third island, Pulau Bidan, a small-uninhabited island, formerly used as a military base. This island is packed with vegetation, especially timber trees, and rises sharply to almost 83 mm above sea level to a ridge. There are areas of sandy beach, but most of the shoreline is rocky without a sandy beach, and has steep sheer cliffs and also waterline caves.

(ii) The Flora

A total of 108 collections of flowering plants were collected, which included 102 species in 67 genera and 55 families. Some collections are still being identified. In addition, several important endemics, rare and coastal species were found during the expedition (Turner, 1997) and it is shown in Table 2.10.2.

Table 2.10.2. List of endemics and rare species that were found during the expedition.

	Species	Description
Coastal species	*Archidendron contortum* (Martelli) I.C. Nielsen.	Shrub or small tree to 10 m tall; common in secondary forest, usually near the sea; widespread.
	Canavalia rosea (Sw.) DC.	Trailing vine; sandy shores; all coasts.
	Caesalpinia bonduc (L.) Roxb.	Prickly liana to 15 m tall; often coastal but also found inland; widespread
	Entada spiralis Ridl.	Woody climber to 25 m long; lowland forest to 540 m; south of the Peninsula.
	Thespesia populnea (L.) Sol. *ex* Corrêa	Tree to 15 m tall; sandy and rocky shores; all coasts
	Ipomoea violacea L.	Woody twining vine; sea shores

Table 2.10.2. (Continue).

	Species	Description
Montane species	*Begonia sibthorpioides* Ridl.	Tiny tuberous herb about 3 to 4 cm high, usually on cliff face; endemic in Gunung Jerai peak.
	Utricularia striatula Sm.	Tiny herb about 5 to 7 cm high on very wet rocks surface, common in montane only.
	Utricularia involvens Ridl.	Wiry herbs with twining inflorescences up to 60 cm long common in damp grassy places on slope, only found at Gunung Jerai, Kedah
	Corybas geminigibbus J.J.Sm.	Tiny tuberous one-leaved herb orchid at montane forest and known only from Gunung Jerai, Kedah
	Torenia atropurpurea Ridl.	Creeping herb; banks in montane forest; recorded in Kedah, Perak, Pahang and Selangor.
	Sonerila calophylla Ridl.	Succulent herb to 20 cm tall, endemic in Gunung Jerai, Kedah.
	Sonerila linearis Hook.*f*.	Slender herb to 40 cm tall; hill forest; endemic in Gunung Jerai, Kedah.
	Nepenthes albomarginaa Lobb *ex* Lindl.	Slender climber; hills and mountains.

Discussion and Recommendation

Only a few families and species were flowering and fruiting in most of the areas visited. The common sandy beach species such as *Ipomea*, *Thespesia* were dominant on the three islands. Several interesting Leguminosae were encountered including native *Entada spiralis,* which was found climbing on the canopy in Pulau Songsong, a prickly liana *Caesalpinia bonduc* dominated on Pulau Bidan beach, and *Ipomoea violacea*, commonly called beach moon flower or sea moon flower as the flowers open at night, which found abundantly in Pulau Telur.

The flora of the three islands are coastal species. As far as we aware, there are no specific published flora accounts for the islands. However, a few species were mentioned by Ridley in his 1900 journal article, 'A Botanical Excursion to Gunung Jerai (Kedah Peak)'. Ridley landed in the islands in 1893 on his way to Yan. In his journal, he mentioned a few plants, such as *Swintonia spicifera*, *Anisoptera curtisii*, *Atalantia monophyla*, *Cordia sebestana*, *Ruellia prostrata*, *Aerides odoratum*, *Eria bractescens*, *Cirrhophetalum medusae*, *Cymbidium aloifolium*, *Dendrobium crumenatum* and *Adiantum capilus-veneris.*

Our recent survey found that most coastal species are found surrounding the island. However, the forest on the island we believe had been logged over before, since the island had been made as an army training camp. Many species observed are secondary species. Futhermore, Ridley also mentioned that the islands were thickly wooded with fairly large trees. On recent trip, we saw only a few big trees. However, we still found *Swintonia* fruit on

the forest floor as mentioned by him. This probably, *Swintonia* sp. is a very common species in Pulau Songsong.

Pulau Songsong has a sandy and rocky beach with rocky steep hill inland up to the ridge. Some of the plants collected during the survey are *Acrotrema inophyllum*, *Colubrina asiatica*, *Canavalia rosea*, *Cayratia mollissima*, *Elaeocarpus serratus*, *Stachytarpheta cayennensis, Entada spiralis*, *Leea angulata*, *Melanthera biflora*, *Vitex pinnata*, *Volkameria inermis*, *Menispermum* sp., *Thespesia populnea*, *Tetrastigma* sp. On the top of the Pulau Songsong hill, the forest was a bit disturbed. Some species collected are *Archidenron contortum*, *Champereia griffithii*, and *Phyrrosia lanceolata*.

On a second day, we went to Pulau Bidan. Unfortunately, heavy rain delayed collecting activity, so collections made were much less. Some species collected from Pulau Bidan are *Canavalia rosea*, *Caesalpinia bonduc*, *Pandanus elliptica*, *Dendrobium crumenatum*, *Fordia splendidissima*, *Ficus fistulosa*, *Casuarina equisetifolia*, *and Portulaca tiliaceus*.

During the last day collecting in Pulau Songsong, we had a quick stop at Pulau Telur. Pulau Telur seems to have an intact forest. We collected a few plants from there such as *Ipomoea violacea*, *Canavalia rosea*, *Wollastonia biflora*, *Tetracera scandens*, *Melicope* sp., *Gnetum* sp. Due to time limitation and bad weather, we did not get the chance to do extensive collection on this island.

We had a one-day survey on the top of Gunung Jerai peak. We collected around the peak of Gunung Jerai and along the main road on the top area. Some of the collections are plants that are well known to Gunung Jerai and endemic to Gunung Jerai such as *Begonia sibthorpioides*, *Utricularia involvens* or are species common in montane forest like *Utricularia striatula*. We also found *Fagraea splendens*, which a new record species for Gunung Jerai, previously only *Fagraea racemosa* (Faridah-Hanum *et al* 2006). Some species like *Sonerila calophylla*, *Sonerila linearis* and *B. sibthorpioides* were found flowering abundantly on rocky areas on the top peak. All three are endemic to Gunung Jerai (Ridley 1916). We also found *Nepenthes albomarginata*, a slender climbing plant also in flowering. Besides that, a striking yellow flower of gesneriad, *Didymocarpus citrina* was also in flowering. Some other species found along the main road are, *Burmannia disticha*, *Xyris bancana*, *Torenia atropurp*urea, *Ludisia discolor* and *Ardisia rosea*.

On the Islands, the diversity of coastal species is quite high. Some species found were similar within the three islands, but most were totally different leading us to believe that there are many different floristic components compared with the previous record. Some species might have interesting facts as the changing of the vegetation.

The few days flora survey was not allow enough time to get a complete checklist for Pulau Songsong and Gunung Jerai. However, from this expedition, we can conclude the Pulau Songsong up to Gunung Jerai is very valuable and a gem to Yan District. We realised how precious Yan District to the State of Kedah and Peninsular Malaysia. The flora of the islands and Jerai highland offer the opportunity to see the differences of vegetation and flora from coastal to lowland dipterocarp forest towards mountain forest.

A comparison of current and previous plants collected coud also be done. However, extensive fieldwork to fully cover the different trails, areas and elevations are needed. As a recommendation, we would like to suggest a guidebook for the flowering plants of the Songsong group of islands (Pulau Songsong, Pulau Bidan and Pulau Telur) and Gunung Jerai for the layman. The high diversity of floristic and vegetation from coastal Islands to highland of Gunung Jerai is valuable to be promoted to the more international level. This effort should be done with collaboration with stakeholders, university and research institutes. We believe this is very important to portray the gems of Songsong group of islands and

Gunung Jerai to the community and stakeholder. This will increase an understanding of importance of protecting our forest and the importance of managing the forest towards the green sustainable approach.

Conclusion

Diversity of flora of the Songsong group of islands and peak of Gunung Jerai is very good. Some rare and interesting plants were found during this expedition with fruiting and flowering materials collected that are important for taxonomic work. Therefore, this area must be properly managed and protected. The three islands are very precious to compliment the flora of Gunung Jerai itself. To sustain the diversity of flora and vegetation, proper management and legal protection are needed in order to conserve the remaining forest that are valuable for research, eco-tourism, nature education and research.

Acknowledgements

The botanical team would like to thank the Department of Marine Park Malaysia and CEMACS, USM for inviting us to join the expedition and Jabatan Perhutan Negeri Kedah, for the permit for botanical collection. We are indebted to Dr. Richard Chung Cheng Kong and Dr Ruth Kiew for comments on the manuscript.

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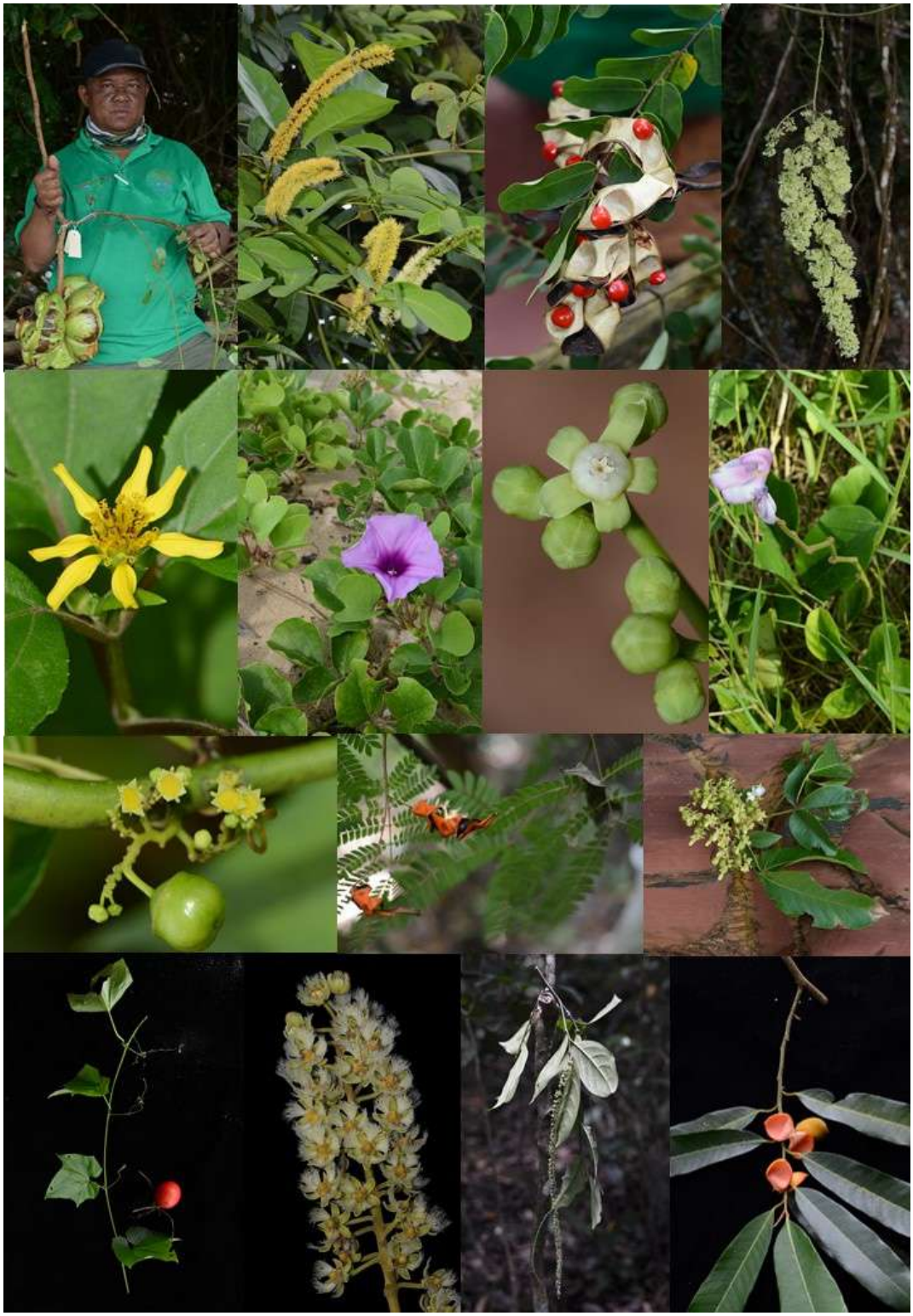

Pulau Songsong. From top on left; *Entada spiralis* (Fruit), *Entada spiralis* (Flower), *Adenanthera pavonina*, *Menispermum* sp., *Melanthera biflora*, *Ipomoea pes-caprae*, *Leea angulata*, *Canavalia rosea*, *Colubrina asiatica Archidendron contortum Vitex pinnata*, *Trichosanthes quinquangulata*, *Elaeocarpus serratus*, *Knema* sp. (Photos by Siti Munirah MY & Ummul Nazrah AR).

Pulau Bidan. From top on left; *Pandanus elliptica*, Leguminosae, *Caesalpinia bonduc*, *Dendrobium crumenatum*, *Ficus fistulosa*, *Fordia splendidissima*, *Thespesia populnea* (flower front view), *Thespesia populnea* (flower side view) (Photos by Siti Munirah MY).

Pulau Telur. From top on left; *Ipomoea violacea* (Habit), *Ipomoea violacea* (Flower), *Canavalia rosea* (Photos by Siti Munirah MY).

Gunung Jerai. From top on left; *Fagraea splendens*, *Utricularia involvens*, Leguminosae, *Sonerila calophylla*., *Nepenthes albomarginata*, *Utricularia striatula*, *Burmannia disticha*, *Begonia sibthorpioides*, *Didymorcarpus citrina*. (Photos by Siti Munirah MY & Ummul Nazrah AR).

2.11 PRELIMINARY SUMMARY OF THE FLORA OF PULAU SONGSONG, PULAU BIDAN, PULAU TELUR AND GUNUNG JERAI IN YAN, KEDAH, MALAYSIA

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Introduction

Pulau Songsong, Pulau Bidan and Pulau Telur are three small islands c. 9 km off the coast of Pantai Murni, Yan, Kedah, Malaysia. About 3.5 km to the east of Pantai Murni is Gunung Jerai or Kedah Peak. As contrast to Gunung Jerai with the early botanical review since colonial time (Ridley, 1900), these nearby islands had not been botanically explored and documented. Pulau Songsong was a training target for Australian air force and was restricted from public before 2008 (Rattanachot, 2011). Recently, Biodiversity and Conservation Unit of Penang Botanic Gardens (PBG) had joined effort with Forest Research Institute Malaysia (FRIM) as the Flora Group to survey the flora of these islands and Kedah Peak in H2O Songsong-Jerai Expedition organized by Department of Marine Park Malaysia and Centre of Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia (USM).

Objectives

1. To provide a preliminary summary of the flora on Pulau Songsong, Pulau Bidan, Pulau Telur, and

2. To identify rare or aesthetic native plants for conservation purposes.

Materials and Methods

Field sampling was carried out at Pulau Songsong, Pulau Bidan, Pulau Telur, Pantai Murni and Gunung Jerai from 28th September to 1st October 2017 (Table 2.11.1). In this study, plants with flowers or fruits were collected as dried herbarium specimens, spirit/alcohol collections and/or dried carpological collections. Plants without fertile parts were also collected as voucher specimens. Morphology characters (vegetative and reproductive) were observed and measured. Locality data was recorded as well. Images were taken using digital camera. Herbarium specimens were deposited to Penang Botanic Gardens Herbarium (PBG) and Forest Research Institute Malaysia Herbarium in Kepong (KEP). Living collections were collected and cultivated at Penang Botanic Gardens, Pulau Pinang.

Table 2.11.1. Dates and locations of the field survey.

Date	Location
28 September 2017	Pulau Songsong (coastal)
29 September 2017	Pulau Bidan (coastal to peak)
30 September 2017	Gunung Jerai (peak)
1 October 2017	Pulau Songsong (peak) Pulau Telur (coastal) Pantai Murni (coastal)

Results

A total of 103 accessions were collected including 52 accessions from Pulau Songsong, 19 accessions from Pulau Bidan, two accessions from Pulau Telur, one accession from Pantai Murni and 29 accessions from Gunung Jerai. At least 76 species belong to 51 families were encountered during this expedition (Table 2.11.2). Sixty-three of these samples (48 from islands and 15 from Gunung Jerai) were identified to at least genus level (Table 2.11.3).

Table 2.11.2. List of families and the number of species.

Families	Number of Species
Adiantaceae	1
Anacardiaceae	2
Annonaceae	1
Araceae	5
Asclepiadaceae	2
Asparagaceae	1
Begoniaceae	1
Bignoniaceae	1
Burseraceae	1
Combretaceae	1
Compositae	2
Cucurbitaceae	1
Cyperaceae	1
Dipterocarpaceae	1
Ebenaceae	1
Elaeocarpaceae	3
Gesneriaceae	1
Goodeniaceae	1
Gramineae	2
Labiatae	2
Lecythidaceae	1
Leeaceae	1
Leguminosae	6
Malvaceae	1
Melastomataceae	3
Meliaceae	1
Memecylaceae	1
Moraceae	1
Myristicaceae	2
Myrsinaceae	1
Myrtaceae	1
Nepenthaceae	1
Opiliaceae	1
Orchidaceae	3
Palmae	2
Pandanaceae	1
Phyllanthaceae	1
Piperaceae	1
Podocarpaceae	1
Polypodiaceae	1
Rhamnaceae	1
Rubiaceae	1
Rutaceae	1

Table 2.11.2. (Continue).

Families	Number of Species
Sapindaceae	1
Sapotaceae	2
Simaroubaceae	1
Smilacaceae	1
Tectariaceae	1
Verbenaceae	2
Vitaceae	2
Zingiberaceae	1

Table 2.11.3. List of identified species.

	Families	Species
Islands	Anacardiaceae	*Swintonia* sp.
	Annonaceae	*Goniothalamus* sp.
	Araceae	*Aglaonema* sp.
	Araceae	*Alocasia* sp.
	Araceae	*Anadendrum* sp.
	Araceae	*Pothos scandens*
	Asclepiadaceae	*Hoya* sp.
	Asclepiadaceae	*Dischidia* sp.
	Asparagaceae	*Dracaena* sp.
	Combretaceae	*Terminalia catappa*
	Compositae	*Wollastonia biflora*
	Cucurbitaceae	*Trichosanthes* sp.
	Cyperaceae	*Fimbristylis* sp.
	Dipterocarpaceae	*Anisoptera* sp.
	Ebenaceae	*Diospyros* sp.
	Elaeocarpaceae	*Elaeocarpus serratus*
	Elaeocarpaceae	*Elaeocarpus* sp.
	Fabaceae	*Clitoria* sp.
	Fabaceae	*Adenanthera pavonina*
	Fabaceae	*Archidendron* sp.
	Fabaceae	*Derris* sp.
	Fabaceae	*Entada* sp.
	Goodeniaceae	*Scaevola* sp.
	Gramineae	*Dinochloa* sp.
	Labiatae	*Vitex* sp.
	Labiatae	*Volkameria inermis*
	Lecythidaceae	*Barringtonia* sp.
	Leeaceae	*Leea* sp.
	Malvaceae	*Thespesia populnea*
	Memecylaceae	*Memecylon* sp.
	Moraceae	*Ficus* sp.
	Myristicaceae	*Knema* sp.
	Myristicaceae	*Myristica* sp.

Table 2.11.3. (Continue).

	Families	*Species*
	Myrsinaceae	*Ardisia* sp.
	Myrtaceae	*Syzygium* sp.
	Opiliaceae	*Lepionurus sylvestris*
	Palmae	*Caryota mitis*
	Palmae	*Livistona speciosa*
	Pandanaceae	*Pandanus* sp.
	Phyllanthaceae	*Antidesma* sp.
	Polypodiaceae	*Pyrrosia* sp.
	Rhamnaceae	*Colubrina asiatica*
	Rubiaceae	*Zuccarinia macrophylla*
	Sapotaceae	*Palaquium* sp.
	Simaroubaceae	*Eurycoma* sp.
	Smilacaceae	*Smilax* sp.
	Verbenaceae	*Lantana camara*
	Vitaceae	*Cayratia* sp.
Gunung Jerai	Adiantaceae	*Adiantum* sp.
	Araceae	*Scindapsus scortechinii*
	Begoniaceae	*Begonia sibthorpioides*
	Compositae	*Bidens pilosa*
	Gesneriaceae	*Didymocarpus*
	Gramineae	*Maclurochloa montana*
	Melastomataceae	*Sonerila calophylla*
	Melastomataceae	*Sonerila linearis*
	Moraceae	*Ficus* sp.
	Myrsinaceae	*Ardisia* sp.
	Nepenthaceae	*Nepenthes albomarginata*
	Orchidaceae	*Anoectochilus* sp.
	Orchidaceae	*Coelogyne* sp.
	Orchidaceae	*Peristylus* sp.
	Tectariaceae	*Tectaria* sp.

Discussion

All study areas are within the Northern Region of Malaysia, which may largely similar to the Southern Thailand and Northern Sumatra with almost same climate. These islands are having sandstone bedrock and Gunung Jerai is known to have sandstone bedrock as well (WWF Malaysia, 1977). Notably, the other islands in Kedah with botanical records, such as Pulau Payar and Pulau Langkawi, are having granite bedding with some limestone area at latter). The rocks on Pulau Songsong are very loose probably due to this island used to be the military targeting site.

All beach areas are commonly populated with small trees and shrubs (*Thespesia populnea*, *Casuarina* sp., *Cocos nucifera*, *Pandanus* sp.; Figure 2.11.1 A) and some creepers (*Ipomoea* sp., *Clitoria* sp.; Figure 2.11.1 C & D). Sometimes, the beach area is slightly disturbed with *Fimbristylis* grass and *Stachytarpheta jamaicensi*. Although the creepers are common, their constant flowering may be a main food source for supporting the bees'

population on the islands. After the beach area, there are several local lowland tree species, such as *Diospyros* sp., *Elaeocarpus serratus*, *Myristica* sp., and *Ficus* sp.. Few uncommon plants were found near coast at Pulau Songsong, especially *Erycibe* sp. which the fruits were reported as a tapir food (Figure 2.11.1 E) and the woody climber with very large pods, *Entada* sp. (Figure 2.11.1 F). Around the slopes of Pulau Songsong, there are few juvenile plants of *Livistona speciosa* palm, many *Caryota mitis* palm, many medium-size trees in Anacardiaceae family (mostly *Mangifera* sp.) and a remarkable *Swintonia* species with the 5-winged fruits (Figure 2.11.1 G). Few large tree species, *Anisoptera* sp. (Figure 2.10.2 A) and a Burseraceae species is remain on the peak. As the lowland areas on mainland are usually fast converted and urbanized, perhaps the lowland species dispersed on these islands may serve as the reservoir for these plants. Besides, at Pulau Bidan beach, *Scaevola* sp. with the creepers provide a natural landscape (Figure 2.11.2 B). Astonishingly, the climbing bamboo, *Dinochloa sp*, was found in Pulau Bidan (Figure 2.11.2 D), which is probably endemic to Peninsular Malaysia because the *Dinochloa* '*scandens*' here are believed to be a species complex (Wong, 1995). This species is different from another climbing bamboo, *Maclurochloa montana,* at the other side on Gunung Jerai (Figure 2.11.2 C). The vegetation of the islands is very different from the lower montane forest of Gunung Jerai. Although Gunung Jerai peak is well-known for the orchids (e.g. *Anoectochilus* sp., *Coelogyne* sp., *Peristylus* sp.), those other small lithophytes on mossy rocks like *Begonia sibthorpioides* and *Sonerila linearis* are very aesthetic, rare and originally described from there.

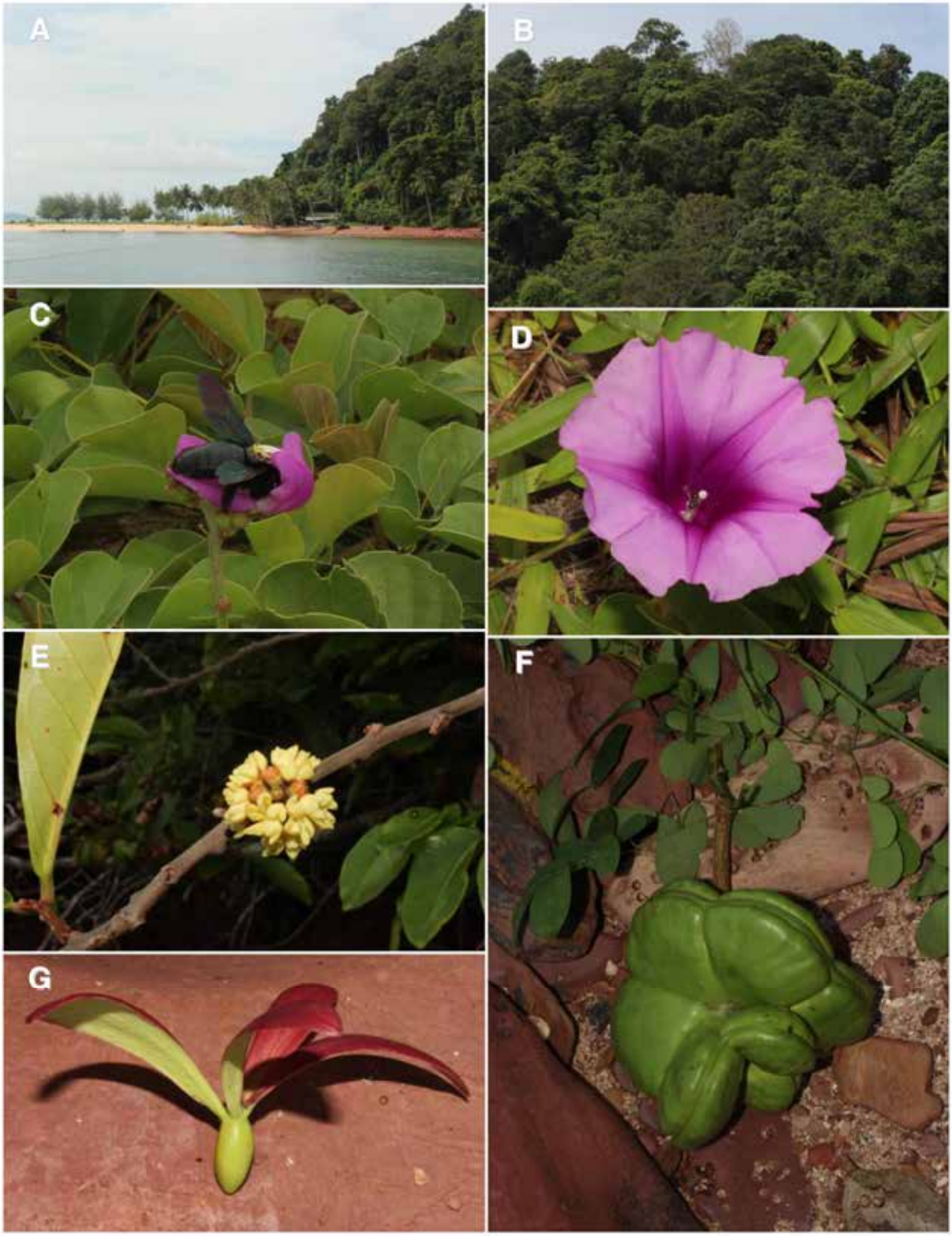

Figure 2.11.1. A: vegetation on the beach of Pulau Songsong; B: vegetation on the hill of Pulau Songsong; C: *Clitoria sp* was visited by a *Xylocopa* bee; D: *Ipomoea sp* was visited by a stingless/sweat bee; E: flowers of *Erycibe sp*; F: the pod of *Entada sp* (JKB2170); G: the fruit of *Swintonia sp*. (JKB2173) – © Ooi Im Hin.

Figure 2.11.2. A: *Anisoptera sp* at the peak of Pulau Songsong (Songsong19); B: *Scaevola sp* at beach of Pulau Bidan (JKB2176); C: *Maclurochloa montana* at Gunung Jerai (G.Jerai5); D: *Dinochloa sp* at Pulau Bidan (Bidan1); E: flowers of *Begonia sibthorpioides* (JKB2190); F: flowers of *Sonerila linearis* (JKB2193) – © Ooi Im Hin.

Recommendations

The disturbance to the vegetation on these islands should be minimized, especially Pulau Songsong to prevent erosion and falling of the loose rocks but these vegetations are also ecologically interacting with animals, such as bees, birds and bats. Wong (1995) suspected there may be three *Dinochloa* species in Peninsular Malaysia. A species, *Dinochloa malayana,* was described from Peninsular Malaysia by Dransfield (1996). Specialist is needed to investigate on this population.

Conclusion

A preliminary summary of the flora on these islands (Pulau Songsong, Pulau Bidan, Pulau Telur) was provided with approximately 60 species found. Rare or aesthetic native plants were recognised and briefly discussed.

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2.12 DIVERSITY CHECKLIST OF HERPETOFAUNA AT GUNUNG JERAI, YAN, KEDAH

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Introduction

Gunung Jerai has a height of 1217 meters is a symbol of the splendor of the people of Kedah. Its temperature is from 19 to 24 degrees Celsius, which makes it a tourist attraction from both domestic and overseas. Come to enjoy the fresh and cold air and observe the beautiful panorama of the Jerai summit. From the peak of Jerai can be seen as a vast ocean and nearby islands such as Pulau Bidan, Pulau Telur, Pulau Songsong and Pulau Bunting.

Pulau Songsong is the island that is in the waters of the Province of Yan as well as the islands mentioned earlier. It is a beautiful and attractive island. For visitors who come to this island to relax and picnic with the family is very appropriate. With clear seawater, we can look into the sea floor; it is rich in marine life and beautiful coral reefs.

Various species of herpetofauna and small mammals that are in Gunung Jerai and Pulau Songsong, little data was successfully observed over the intended time allocation. But it is sufficient for us to know the existence of the species here. In the coming days it is hoped that we will be able to conduct a study here again to find further data on herpetofauna and small mammals that we have not yet known and obtained.

Objectives

The objectives of this inventory are:

1. To collect current information related to flora and fauna around Gunung Jerai and Pulau Songsong,

2. To find out the distribution and diversity of flora and fauna species found around Gunung Jerai and Pulau Songsong,

3. To identify ecotourism attractions around Gunung Jerai and Pulau Songsong, and

4. To identify areas for habitat enrichment.

Materials and Methods

For the study of herpetofauna and small mammals in Gunung Jerai it was conducted in three areas, which are Titi Hayun, Batu Hampar and Sungai Teroi, whereby at Pulau Songsong it was conducted around the island.

The three methods that were used in this study are as below:

(a) Active search.

This method is often used in herpetofauna studies. All species of amphibians and reptiles found during the jungle rifts and juicy areas will be captured and taken to the study tent for identification. The study was conducted from 0830 to 1200 at noon and 2000 to 2400 hours at night. Amphibian studies are easier to carry out at night because they are nocturnal animals and the detection by sound and eye shine greatly helps the study. In addition, snake-like reptiles also go out at night to find food. Capture methods using department-

brace are used to reduce risk. Herpetofauna that gets caught will be turned off and made identifiable. Unrecognized herpetofauna species will be specimens for the identification process by those who are more experts. The individual will be switched off using Tricane and injected with Formalin 10% before entering into 70% alcohol solution a few hours later.

(b) Cage trap

This method is often used in small mammal studies. This method is used to capture rat and squirrel species. Attached to the tracked track, the distance between the traps is 10 meters in straight line. Installation of the trap is by using bait. Feed habits used are palm oil and salted fish. Daily checks are performed. To prevent the individual in the cage trap, die or decay and will make it difficult to identify.

(c) Harp trap

This method is often used in small mammal studies. This method is used to capture bat species. Installed at the tracked track in straight line. Do not need using bait. Daily checks are performed. To prevent the individual that trapped in the trap die.

Results and Discussion

From the study, 14 species of herpetofauna have been recorded in Gunung Jerai area and 1 species in Pulau Songsong (Table 2.12.1). Comprising of 11 species of amphibians (*Rhacophoridae*, *Bufonidae*, *Dicroglossidae* and *Ranidae*) and 1 *Colubridae* (snake), 1 *Gekkonidae* (gecko), 1 *Agamidae* (lizards) and 1 *Scinidae*.

The number of species on the program is a bit less. Results may be affected by Gunung Jerai area which is active by extreme sports enthusiasts, while short time on the Pulau Songsong. However, we believe there are still many herpetofauna species in this area and need to be preserved so that they are not extinct. In order to keep them alive, continuous conservation is essential. Hopefully this precious treasure can be seen by future generations.

References

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Lizards of Peninsular Malaysia, Singapore and Their Adjacent Archipelagos. By Larry Lee Grismer

Reptiles South-East Asia. By Indraneil Das

Table 2.12.1. List of identified species.

No	Family	Genus	Species	Snout Vent Length (mm)	Total Length (mm)	Weight (g)	Sex	Locality
1	*Scinidae*	*Eutrophis*	*multifasciata*	80.4	141.8 (Tail)	N/A	M	Pulau Songsong
2	*Rhacophoridae*	*Polypedetes*	*discantus*	65.5	35.9	N/A	F	Titi Hayun
				43.7	23.9	N/A	M	Titi Hayun
				43.6	25.9	N/A	M	Sg. Teroi,G. Jerai
			leucomystax	70.5	36.8	N/A	F	Titi Hayun
				46.9	26.9	N/A	M	Titi Hayun
3	*Bufonidae*	*Phrynoidis*	*asper*	80.0	40.7	N/A	N/A	Titi Hayun
4	*Dicroglossidae*	*Fejervarya*	*limnocharis*	52.2	27.3	N/A	M	Sg. Teroi,G. Jerai
				32.3	20.6	N/A	M	Sg. Teroi,G. Jerai
				53.1	29.4	N/A	F	Sg. Teroi,G. Jerai
				32.8	19.3	N/A	M	Sg. Teroi,G. Jerai
				28.6	17.5	N/A	M	Sg. Teroi,G. Jerai
				32.1	16.7	N/A	M	Sg. Teroi,G. Jerai
				50.2	26.3	N/A	M	Sg. Teroi,G. Jerai
		Occidozyga	*sumatrana*	22	18.2	N/A	F	Sg. Teroi,G. Jerai
				23.2	18.8	N/A	M	Sg. Teroi,G. Jerai
				22	18.2	N/A	F	Sg. Teroi,G. Jerai
		Limnonectes	*blythii*	76.6	47.1	N/A	F	Sg. Teroi,G. Jerai
				82.3	48.7	N/A	F	Sg. Teroi,G. Jerai
			laticeps	36.5	21.6	N/A	M	Sg. Teroi,G. Jerai
			deinodon	41	20.4	N/A	M	Sg. Teroi,G. Jerai
			malesianus	35.9	22.5	N/A	F	Sg. Teroi,G. Jerai
				60.1	38.6	N/A	M	Sg. Teroi,G. Jerai
				84.5	51	N/A	M	Sg. Teroi,G. Jerai

Table 2.12.1. (Continue).

No	Family	Genus	Species	Snout Vent Length (mm)	Total Length (mm)	Weight (g)	Sex	Locality
5	*Ranidae*	*Odorrana*	*monjerai*	42.3	28.3	N/A	M	Sg. Teroi,G. Jerai
				46.3	29.2	N/A	M	Sg. Teroi,G. Jerai
				46.4	31.7	N/A	M	Sg. Teroi,G. Jerai
				46.6	30.6	N/A	M	Sg. Teroi,G. Jerai
			hosii	82	53	N/A	F	Sg. Teroi,G. Jerai
6	*Colubridae*	*Ahaetulla*	*nasuta*	1000	427 (Tail)	59.9	M	Sg. Teroi,G. Jerai
7	*Agamidae*	*Draco*	*taeniopterus*	100.6	194 (Tail)	N/A	M	Sg. Teroi,G. Jerai
8	*Gekkonidae*	*Gehyra*	*mutilata*	46.1	35.5 (Tail)	N/A	F	Sg. Teroi,G. Jerai

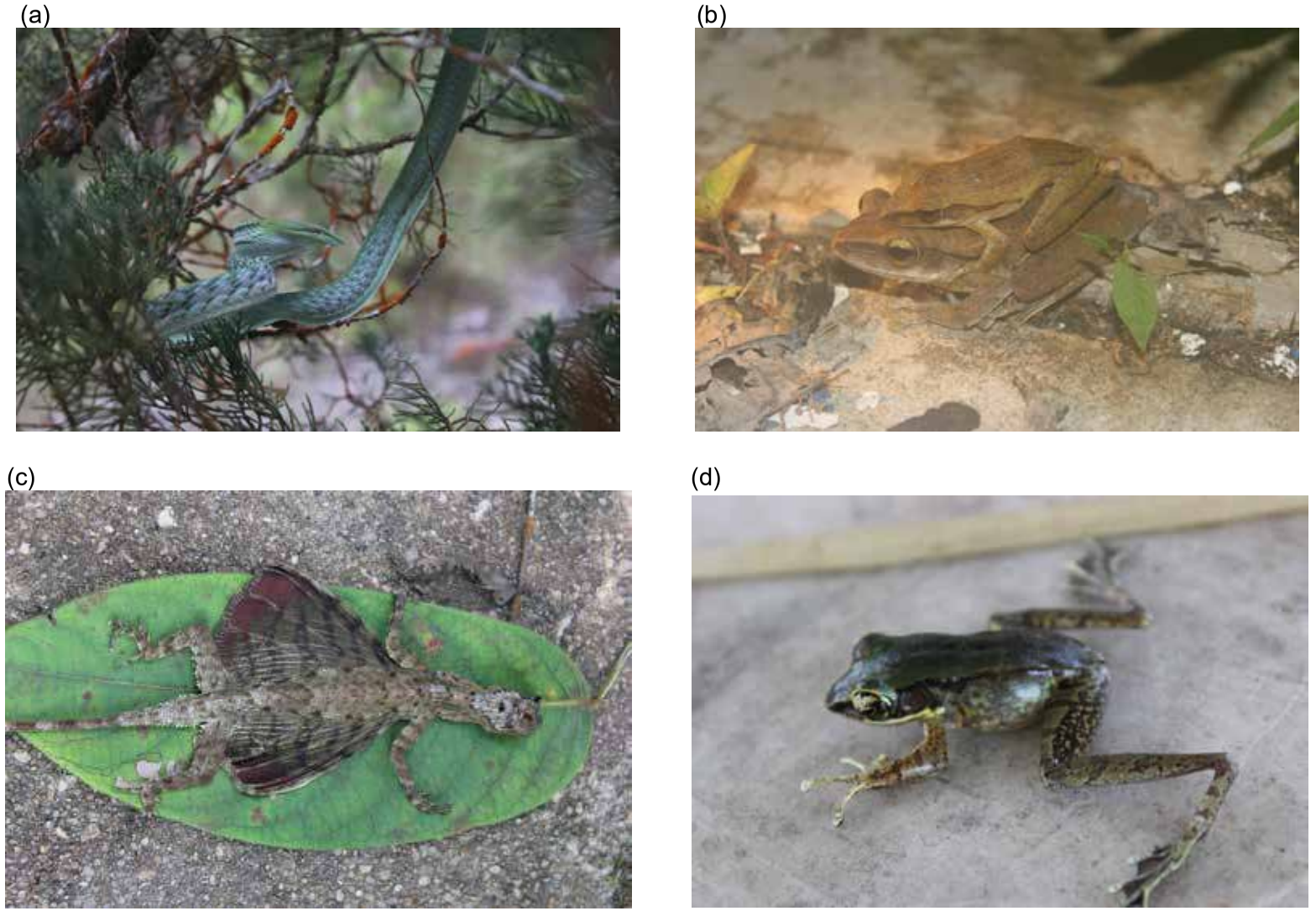

Figure 2.12.1. Some images of herpetofauna of Gunung Jerai *(a) Ahaetulla nasuta; (b) Polypedates leucomystax; (c) Draco taeniopterus and (d) Oddorana monjerai (endemic species).*

2.13 THE BIRDS OF SONGSONG ISLAND CHAIN AND GUNUNG JERAI OF KEDAH

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ABSTRACTS

A rapid bird survey was carried out for the Songsong island chain including Pulau Bidan and its surrounding sea. The surveys were conducted using boat for the marine area and on foot for the islands. Gunung Jerai and its surrounding forest, scrubland, orchard, plantations, mangrove and paddy field including its shore and coastal areas were conducted using motorised vehicle and on foot. A literature search for bird data and re-assessment of previous bird records was carried out for the above mentioned areas. A checklist was generated based on the rapid survey, historical records from the literature search and from current records obtained from published records in bird databases, internet social media, including records from numerous branch trips made by the Malaysian Nature Society (MNS) members to the said areas. A total of 87 species was recorded for the Song Song island chain, and its surrounding seas, and a total of 314 species was recorded for Gunung Jerai and its surrounding areas. The total for the whole region is 337 species. The results indicates that the sea surrounding the Song Song chain of island has a large congregation of migratory terns, a regular site for the migratory short-tailed shearwaters, and three species of migratory jaegers or skuas. The results from this survey as with previous bird surveys also indicate that the number of truly montane birds at Gunung Jerai is either sparse or non-existent. There have been speculations that Gunung Jerai was previously an island and the Song Song island chain were previously connected by land to the mainland, based on these results, a discussion on these aspect is being made in this paper. Various bird species are proposed as iconic to the Songsong island chain and the Gunung Jerai area for the purpose of conservation, including creating any marine park, state or national parks or eco-tourism destinations.

Introduction

The first major bird survey (in addition to animals survey) was done for the Gunung (mountain) Jerai area was during the early twentieth century by Robinson and Kloss, (1916) of which the survey also included the nearby Gurun area. Some of the post Second World War bird survey for Kedah included that by Bromley (1949). There was an animal with bird survey carried on the 15-17th October 1976 by World Wide Fund Malaysia (WWF-Malaysia 1977). The Department of Wildlife and National Park in 1986 carried out a bird (and mammal) survey and ringing for 5 days at Gunung Jerai (Siti Hawa Yatim-1986). This was followed by Gregory-Smith (1994) with a major survey in the period of 1991-1993 for Gunung Jerai, Sungai Merbok and the other parts of Kedah. His studies were subsequently published in 1995 - *A Checklist of the Birds of Perlis, Kedah and Langkawi*. (Gregory-Smith, 1995). And in conjunction with a Scientific Expedition organized by *Jabatan Perhutanan Semenanjung Malaysia*, Ekspedisi Saintifik Kepelbagaian *Biologi* Hutan *Gunung Jerai*, *Kedah* 4th – 10th June 2005, 3 papers were published related to the avifauna of Gunung Jerai (Mohamed Zakaria *et al.,* 2006). A literature survey and a reassessment of previous records were made included those mentioned above and Wells, *The Birds of Thai-Malay Peninsula Volume 1* published in 1999 and *Volume 2* published in 2007. And the more recently published revised edition of Allen J., *Birds of*

Peninsular Malaysia and Singapore, 2012. The publications by Wells and Allen J. would have included most of the data collected and collated by Malaysian Nature Society (MNS) and the most recent bird sightings were made at “eBird” Malaysia which would have included all of the previous MNS-BIW data. The unpublished bird records of the MNS, and its branch trip and members trip to the area, starting from the mid 70’s to Gunung Jerai and including Songsong island chain and its surrounding sea from about 2009 and continues to the present day (September 2017) were also included in this report.

Materials and Methods

The scientific expedition was carried out to evaluate the interconnectivity of the land and sea biodiversity and the unique and richness of the faunas of the aves group that can be found around the northwestern part of West Malaysia.

The present survey involves the areas of Hutan Lipur Sungai Teroi, -Titi Hayuan, -Seri Perigi, -Tupah, the Jeep track from the bottom untill Jerai Regency Resort summit and from there towards the direction of the Telco installation at the peak of Jerai. The survey also includes the Bujang Archeology Museum sites. The other stretch of survey locations begin from Singkir Laut, Yan mudflats and shore-front, paddy fields from Yan to Guar Chempedak, orchards and kampongs at Yan and the Tanjong Jaga area. As for the islands the embarkation point is from Tanjung Dawai jetty towards the Pulau Songsong, Pulau Bidan and seas between these islands plus the sea towards the shore and Sungai Merbok river mouth (Figure 2.13.1).

Figure 2.13.1. Survey area.

For the survey during this expedition, no mist netting was used and all survey were done by foot for the Songsong island chain, by boat for the seas east of the island chain and by both motorized vehicle and on foot for Gunung Jerai and the surrounding area.

Results and Discussion

The completed Checklist is shown in Table 2.13.1.

(a) For the Songsong group of island and surrounding seas:

i. A total of 87 species was recorded, including those of literature survey, for the Pulau Songsong and Pulau Bidan and the surrounding seas; the following were recorded on the islands of Songsong and/or Bidan.

ii. Pied Imperial Pigeon is very common, less common is the Green Imperial Pigeon, the former considered as an island dependent/specialist – but the later a forest pigeon but do fly to mangroves and off shore islands to feed.

iii. The Mangrove Whistler and Golden-Bellied Gerygone are found on most off shore islands of West Malaysia.

iv. A total of 16 species are considered as expedition records for Pulau Songsong and/or Pulau Bidan, and it includes the following nine resident species; Asian Emerald Dove, Green Imperial-Pigeon, Golden-bellied Gerygone, Mangrove Whistler, Bronzed Drongo, Olive-winged Bulbul, Common Tailorbird, Oriental Magpie-robin and Plain-throated Sunbird.

v. Seven new migratory bird records for these two islands includes; Tiger Shrike, Brown Shrike, Crow-billed Drongo, Asian Paradise-Flycatcher, Asian Brown Flycatcher, Korean Flycatcher, Green-backed Flycatcher. The Asian Paradise-Flycatcher is assumed to be the migratory sub-species.

vi. 13 out of the 14 species of terns found in Malaysian waters, with large congregation of up to 10,000 terns, with the three most common making up this number, White-winged, Common and Bridled. The only species not recorded is the huge Caspian Tern.

vii. All three species of migratory shearwaters that are found in Malaysia- the Short-tailed, Streaked and Wedge-tailed.

viii. All three species of migratory Jaeger/Skua, the Pomarine, Parasitic and Long-tailed.

ix. Two out of the three species of frigatebirds that are known to occur in Malaysian waters can be found here; the Lesser and Greater frigatebird

(b) For Gunung Jerai and surrounding areas:

i. A total of 313 species was recorded including those of literature survey and published and unpublished sightings, although only the Tickell's Blue Flycatcher is considered a new addition to the area recorded during the expedition.

ii. As with previous studies there are few records of strictly montane birds during this expedition and literature search. Except for the Golden-throated Barbet recorded during the Forestry Expedition of 2005, and earlier in 2002-2003 (Shahrul Anuar, 2006) and a much earlier records of the Chestnut-crowned Warbler and the Mountain Bulbul (Siti Hawa Yatim, 1986). The record of the Golden-throated Barbet at 800 m above sea level (asl) is significant being that it is considered as an "upper montane" barbet in West Malaysia, usually regarded to be 1300 m asl.

iii. Some birds previously considered to be "montane" species that are found on Gunung Jerai, example; Streaked Wren-Babbler, Grey-throated Babbler can be found in much lower elevation especially in north-west Peninsular Malaysia.

iv. Some species that have been overlooked in previous studies or not recorded include the following; Blyth's Frogmouth, Scaly-breasted Bulbul, Large Hawk-Cuckoo, Red-bearded Bee eater and the Racket-tailed Treepie.

Note: It is important to study the bird species on all these offshore islands of West Malaysia as it may be used as a model for isolated "forested island" on the mainland. Even Gunung Jerai can be considered as an isolated forested island as its surrounding has been cut off from the main forest range, and housing development changes the previous land use of orchards and plantations, which would have been used as a corridor for certain forest birds.

Table 2.13.1. Checklist of The Birds of Gunung Jerai and Songsong Island Chain.

NO	FAMILY/ COMMON NAME	SCIENTIFIC NAME	JERAI STATUS	SONGSONG STATUS	IUCN STATUS
ANATIDAE (Ducks, Geese, and Waterfowl)					
1.	Lesser Whistling-Duck	*Dendrocygna javanica*	R	X	LC
2.	Blue-breasted Quail	*Synoicus chinensis*	R	X	LC
3.	Red Junglefowl	*Gallus gallus*	R	X	LC
4.	Great Argus	*Argusianus argus*	R	X	NT
PODICIPEDIDAE (Grebes)					
5.	Little Grebe	*Tachybaptus ruficollis*	R,M	X	LC
PROCELLARIIDAE (Shearwaters and Petrels)					
6.	Bulwer's Petrel	*Bulweria bulwerii*	X	V	LC
7.	Streaked Shearwater	*Calonectris leucomelas*	X	M	LC
8.	Wedge-tailed Shearwater	*Ardenna pacifica*	X	M	LC
9.	Short-tailed Shearwater	*Ardenna tenuirostris*	X	M	LC
HYDROBATIDAE (Storm-Petrels)					
10.	Swinhoe's Storm-Petrel	*Oceanodroma monorhis*	X	M	NT
CICONIIDAE (Storks)					
11.	Asian Openbill	*Anastomus oscitans*	M	X	LC
12.	Lesser Adjutant	*Leptoptilos javanicus*	R	X	VU
FREGATIDAE (Frigatebirds)					
13.	Lesser Frigatebird	*Fregata ariel*	X	M	LC
14.	Great Frigatebird	*Fregata minor*	X	M	LC
SULIDAE (Boobies and Gannets)					
15.	Brown Booby	*Sula leucogaster*	X	R	LC
ARDEIDAE (Herons, Egrets, and Bitterns)					
16.	Yellow Bittern	*Ixobrychus sinensis*	R,M	X	LC

17.	Cinnamon Bittern	*Ixobrychus cinnamomeus*	R,M	X	LC
18.	Grey Heron	*Ardea cinerea*	R	R	LC
19.	Purple Heron	*Ardea purpurea*	R,M	R,M	LC
20.	Great Egret	*Ardea alba*	M	R,M	LC
21.	Intermediate Egret	*Mesophoyx intermedia*	R.M	X	LC
22.	Little Egret	*Egretta garzetta*	R,M	M	LC
23.	Pacific Reef-Heron	*Egretta sacra*	R	X	LC
24.	Cattle Egret	*Bubulcus ibis*	R,M	M	LC
25.	Chinese Pond-Heron	*Ardeola bacchus*	M	M	LC
26.	Striated Heron	*Butorides striata*	R,M	R,M	LC
27.	Black-crowned Night-Heron	*Nycticorax nycticorax*	R	R	LC
PANDIONIDAE (Osprey)					
28.	Osprey	*Pandion haliaetus*	M	X	LC
ACCIPITRIDAE (Hawks, Eagles, and Kites)					
29.	Black-shouldered Kite	*Elanus caeruleus*	R	R	LC
30.	Oriental Honey-buzzard	*Pernis ptilorhynchus*	R,M	X	LC
31.	Black Baza	*Aviceda leuphotes*	M	X	LC
32.	Crested Serpent-Eagle	*Spilornis cheela*	R	X	LC
33.	Changeable Hawk-Eagle	*Nisaetus limnaeetus*	R	R	LC
34.	Blyth's Hawk-Eagle	*Nisaetus alboniger*	R	X	LC
35.	Rufous-bellied Eagle	*Lophotriorchis kienerii*	R	X	LC
36.	Black Eagle	*Ictinaetus malaiensis*	R	X	LC
37.	Greater Spotted Eagle	*Clanga clanga*	M	X	VU
38.	Booted Eagle	*Hieraaetus pennatus*	M	X	LC
39.	Grey-faced Buzzard	*Butastur indicus*	M	X	LC
40.	Eastern Marsh-Harrier	*Circus spilonotus*	M	X	LC
41.	Pied Harrier	*Circus melanoleucos*	M	X	LC
42.	Crested Goshawk	*Accipiter trivirgatus*	R	X	LC
43.	Chinese Sparrowhawk	*Accipiter soloensis*	M	X	LC

44.	Japanese Sparrowhawk	*Accipiter gularis*	M	X	LC
45.	Black Kite	*Milvus migrans*	M	X	LC
46.	Brahminy Kite	*Haliastur indus*	R	R	LC
47.	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	R	R	LC
48.	Lesser Fish-Eagle	*Ichthyophaga humilis*	R	X	NT
RALLIDAE (Rails, Gallinules, and Coots)					
49.	Slaty-legged Crake	*Rallina eurizonoides*	M	X	LC
50.	Slaty-breasted Rail	*Gallirallus striatus*	R	X	LC
51.	White-breasted Waterhen	*Amaurornis phoenicurus*	R,M	X	LC
HELIORNITHIDAE (Finfoots)					
52.	Masked Finfoot	*Heliopais personatus*	M	X	EN
CHARADRIIDAE (Plovers and Lapwings)					
53.	Pacific Golden-Plover	*Pluvialis fulva*	M	X	LC
54.	Grey-headed Lapwing	*Vanellus cinereus*	M	X	LC
55.	Red-wattled Lapwing	*Vanellus indicus*	R	X	LC
56.	Lesser Sand-Plover	*Charadrius mongolus*	M	M	LC
ROSTRATULIDAE (Painted-Snipes)					
57.	Greater Painted-Snipe	*Rostratula benghalensis*	R	X	LC
SCOLOPACIDAE (Sandpipers and Allies)					
58.	Whimbrel	*Numenius phaeopus*	M	M	LC
59.	Ruddy Turnstone	*Arenaria interpres*	M	X	LC
60.	Ruff	*Calidris pugnax*	M	X	LC
61.	Curlew Sandpiper	*Calidris ferruginea*	M	X	LC
62.	Long-toed Stint	*Calidris subminuta*	M	X	LC
63.	Red-necked Stint	*Calidris ruficollis*	M	X	LC
64.	Common Snipe	*Gallinago gallinago*	M	X	LC
65.	Terek Sandpiper	*Xenus cinereus*	M	M	LC
66.	Red-necked Phalarope	*Phalaropus lobatus*	X	M	LC
67.	Common Sandpiper	*Actitis hypoleucos*	M	M	LC

68.	Common Greenshank	*Tringa nebularia*	M	X	LC
69.	Marsh Sandpiper	*Tringa stagnatilis*	M	X	LC
70.	Wood Sandpiper	*Tringa glareola*	M	X	LC
71.	Common Redshank	*Tringa totanus*	M	M	LC
TURNICIDAE (Buttonquail)					
72.	Barred Buttonquail	*Turnix suscitator*	R	X	LC
GLAREOLIDAE (Pratincoles and Coursers)					
73.	Oriental Pratincole	*Glareola maldivarum*	M	X	LC
STERCORARIIDAE (Skuas and Jaegers)					
74.	Pomarine Jaeger	*Stercorarius pomarinus*	X	M	LC
75.	Parasitic Jaeger	*Stercorarius parasiticus*	X	M	LC
76.	Long-tailed Jaeger	*Stercorarius longicaudus*	X	M	LC
LARIDAE (Gulls, Terns, and Skimmers)					
77.	Brown-headed Gull	*Chroicocephalus brunnicephalus*	X	M	LC
78.	Little Gull	*Hydrocoloeus minutus*	X	V	LC
79.	Brown Noddy	*Anous stolidus*	X	R	LC
80.	Sooty Tern	*Onychoprion fuscatus*	X	M	LC
81.	Bridled Tern	*Onychoprion anaethetus*	X	R,M	LC
82.	Aleutian Tern	*Onychoprion aleuticus*	X	M	LC
83.	Little Tern	*Sternula albifrons*	R,M	R,M	LC
84.	White-winged Tern	*Chlidonias leucopterus*	M	M	LC
85.	Whiskered Tern	*Chlidonias hybrida*	M	M	LC
86.	Roseate Tern	*Sterna dougallii*	X	R,M	LC
87.	Black-naped Tern	*Sterna sumatrana*	X	R	LC
88.	Common Tern	*Sterna hirundo*	M	M	LC
89.	Great Crested Tern	*Thalasseus bergii*	X	M	LC
90.	Lesser Crested Tern	*Thalasseus bengalensis*	X	M	LC
COLUMBIDAE (Pigeons and Doves)					
91.	Rock Pigeon	*Columba livia*	F/I	F/I	LC

92.	Red Collared-Dove	*Streptopelia tranquebarica*	R	X	LC
93.	Spotted Dove	*Streptopelia chinensis*	R	R	LC
94.	Asian Emerald Dove	*Chalcophaps indica*	R	R**	LC
95.	Zebra Dove	*Geopelia striata*	R	R	LC
96.	Pink-necked Pigeon	*Treron vernans*	R	R	LC
97.	Thick-billed Pigeon	*Treron curvirostra*	R	X	LC
98.	Yellow-vented Pigeon	*Treron seimundi*	R	X	LC
99.	Green Imperial-Pigeon	*Ducula aenea*	X	R**	LC
100.	Pied Imperial-Pigeon	*Ducula bicolor*	X	R	LC
CUCULIDAE (Cuckoos)					
101.	Greater Coucal	*Centropus sinensis*	R	X	LC
102.	Lesser Coucal	*Centropus bengalensis*	R	X	LC
103.	Raffles's Malkoha	*Rhinortha chlorophaea*	R	X	LC
104.	Red-billed Malkoha	*Zanclostomus javanicus*	R	X	LC
105.	Chestnut-breasted Malkoha	*Phaenicophaeus curvirostris*	R	X	LC
106.	Black-bellied Malkoha	*Phaenicophaeus diardi*	R	X	NT
107.	Green-billed Malkoha	*Phaenicophaeus tristis*	R	X	LC
108.	Chestnut-winged Cuckoo	*Clamator coromandus*	M	X	LC
109.	Asian Koel	*Eudynamys scolopaceus*	R,M	R,M	LC
110.	Violet Cuckoo	*Chrysococcyx xanthorhynchus*	R,M	X	LC
111.	Little Bronze-Cuckoo	*Chrysococcyx minutillus*	R	X	LC
112.	Banded Bay Cuckoo	*Cacomantis sonneratii*	R	X	LC
113.	Plaintive Cuckoo	*Cacomantis merulinus*	R	X	LC
114.	Square-tailed Drongo-Cuckoo	*Surniculus lugubris*	R	X	LC
115.	Moustached Hawk-Cuckoo	*Hierococcyx vagans*	R	X	LC
116.	Large Hawk-Cuckoo	*Hierococcyx sparverioides*	M	X	LC
117.	Indian Cuckoo	*Cuculus micropterus*	R,M	X	LC
TYTONIDAE (Barn-Owls)					
118.	Barn Owl	*Tyto alba*	R	R	LC

STRIGIDAE (Owls)					
119.	Sunda Scops-Owl	*Otus lempiji*	R	X	LC
120.	Oriental Scops-Owl	*Otus sunia*	M	X	LC
121.	Barred Eagle-Owl	*Bubo sumatranus*	R	X	LC
122.	Spotted Wood-Owl	*Strix seloputo*	R	X	LC
123.	Brown Wood-Owl	*Strix leptogrammica*	R	X	LC
CAPRIMULGIDAE (Nightjars and Allies)					
124.	Blyth's Frogmouth	*Batrachostomus affinis*	R	X	LC
125.	Malaysian Nightjar	*Lyncornis temminckii*	R	X	LC
126.	Great Eared-Nightjar	*Lyncornis macrotis*	R	X	LC
127.	Large-tailed Nightjar	*Caprimulgus macrurus*	R	R	LC
128.	Savanna Nightjar	*Caprimulgus affinis*	R	X	LC
APODIDAE (Swifts)					
129.	Silver-rumped Needletail	*Rhaphidura leucopygialis*	R	X	LC
130.	Brown-backed Needletail	*Hirundapus giganteus*	R,M	X	LC
131.	Glossy Swiftlet	*Collocalia esculenta*	R	X	LC
132.	Germain's Swiftlet	*Aerodramus germani*	R	R	LC
133.	Pacific Swift	*Apus pacificus*	M	X	LC
134.	Cook's Swift	*Apus cooki*	?	X	LC
135.	House Swift	*Apus nipalensis*	R	R	LC
136.	Asian Palm-Swift	*Cypsiurus balasiensis*	R	X	LC
HEMIPROCNIDAE (Treeswifts)					
137.	Grey-rumped Treeswift	*Hemiprocne longipennis*	R	X	LC
138.	Whiskered Treeswift	*Hemiprocne comata*	R	X	LC
TROGONIDAE (Trogons)					
139.	Orange-breasted Trogon	*Harpactes oreskios*	R	X	LC
UPUPIDAE (Hoopoes)					
140.	Eurasian Hoopoe	*Upupa epops*	M	X	LC
BUCEROTIDAE (Hornbills)					

141.	Oriental Pied-Hornbill	*Anthracoceros albirostris*	R	X	LC
142.	Rhinoceros Hornbill	*Buceros rhinoceros*	R	X	NT
143.	Wreathed Hornbill	*Rhyticeros undulatus*	R	X	LC
ALCEDINIDAE (Kingfishers)					
144.	Common Kingfisher	*Alcedo atthis*	R,M	X	LC
145.	Black-backed Dwarf-Kingfisher	*Ceyx erithaca*	R,M	R,M	LC
146.	Stork-billed Kingfisher	*Pelargopsis capensis*	R	X	LC
147.	Ruddy Kingfisher	*Halcyon coromanda*	R,M	X	LC
148.	White-throated Kingfisher	*Halcyon smyrnensis*	R	R	LC
149.	Black-capped Kingfisher	*Halcyon pileata*	M	X	LC
150.	Collared Kingfisher	*Todiramphus chloris*	R,M	R,M	LC
151.	Rufous-collared Kingfisher	*Actenoides concretus*	R	X	NT
MEROPIDAE (Bee-eaters)					
152.	Red-bearded Bee-eater	*Nyctyornis amictus*	R	X	LC
153.	Blue-throated Bee-eater	*Merops viridis*	R,M	X	LC
154.	Blue-tailed Bee-eater	*Merops philippinus*	R,M	M	LC
155.	Chestnut-headed Bee-eater	*Merops leschenaulti*	R	X	LC
CORACIIDAE (Rollers)					
156.	Dollarbird	*Eurystomus orientalis*	R,M	X	LC
MEGALAIMIDAE (Asian Barbets)					
157.	Sooty Barbet	*Calorhamphus hayii*	R	X	LC
158.	Coppersmith Barbet	*Psilopogon haemacephalus*	R,M	X	LC
159.	Blue-eared Barbet	*Psilopogon duvaucelii*	R	X	LC
160.	Red-crowned Barbet	*Psilopogon rafflesii*	R	X	NT
161.	Red-throated Barbet	*Psilopogon mystacophanos*	R	X	NT
162.	Yellow-crowned Barbet	*Psilopogon henricii*	R	X	NT
163.	Lineated Barbet	*Psilopogon lineatus*	R	X	LC
164.	Golden-throated Barbet	*Psilopogon franklinii*	R	X	LC
165.	Gold-whiskered Barbet	*Psilopogon chrysopogon*	R	X	LC

PICIDAE (Woodpeckers)					
166.	Sunda Woodpecker	*Dendrocopos moluccensis*	R	X	LC
167.	Banded Woodpecker	*Picus miniaceus*	R	X	LC
168.	Crimson-winged Woodpecker	*Picus puniceus*	R	X	LC
169.	Checker-throated Woodpecker	*Picus mentalis*	R	X	LC
170.	Common Flameback	*Dinopium javanense*	R	X	LC
171.	Rufous Woodpecker	*Micropternus brachyurus*	R	X	LC
172.	Buff-rumped Woodpecker	*Meiglyptes tristis*	R	X	LC
173.	Buff-necked Woodpecker	*Meiglyptes tukki*	R	X	NT
174.	Greater Flameback	*Chrysocolaptes guttacristatus*	R	X	LC
175.	Orange-backed Woodpecker	*Reinwardtipicus validus*	R	X	LC
176.	Grey-and-buff Woodpecker	*Hemicircus concretus*	R	X	LC
FALCONIDAE (Falcons and Caracaras)					
177.	Black-thighed Falconet	*Microhierax fringillarius*	R	X	LC
178.	Peregrine Falcon	*Falco peregrinus*	R,M	R,M	LC
PSITTACIDAE (Parrots)					
179.	Blue-crowned Hanging-Parrot	*Loriculus galgulus*	R	X	LC
EURYLAIMIDAE (Asian and Grauer's Broadbills)					
180.	Black-and-red Broadbill	*Cymbirhynchus macrorhynchos*	R	X	LC
181.	Black-and-yellow Broadbill	*Eurylaimus ochromalus*	R	X	NT
PITTIDAE (Pittas)					
182.	Blue-winged Pitta	*Pitta moluccensis*	R,M	X	LC
183.	Mangrove Pitta	*Pitta megarhyncha*	R	X	NT
ACANTHIZIDAE (Thornbills and Allies)					
184.	Golden-bellied Gerygone	*Gerygone sulphurea*	R	R**	LC
VANGIDAE (Vangas, Helmetshrikes, and Allies)					
185.	Large Woodshrike	*Tephrodornis gularis*	R	X	LC
186.	Bar-winged Flycatcher-shrike	*Hemipus picatus*	R	X	LC
187.	Black-winged Flycatcher-shrike	*Hemipus hirundinaceus*	R	X	LC

188.	Rufous-winged Philentoma	*Philentoma pyrhoptera*	R	X	LC
189.	Maroon-breasted Philentoma	*Philentoma velata*	R	X	NT
AEGITHINIDAE (loras)					
190.	Common Iora	*Aegithina tiphia*	R	X	LC
191.	Green Iora	*Aegithina viridissima*	R	X	NT
192.	Great Iora	*Aegithina lafresnayei*	R	X	LC
CAMPEPHAGIDAE (Cuckooshrikes and Minivets)					
193.	Scarlet Minivet	*Pericrocotus speciosus*	R	X	LC
194.	Ashy Minivet	*Pericrocotus divaricatus*	M	X	LC
195.	Bar-bellied Cuckooshrike	*Coracina striata*	R	X	LC
196.	Pied Triller	*Lalage nigra*	R	X	LC
197.	Lesser Cuckooshrike	*Lalage fimbriata*	R	X	LC
PACHYCEPHALIDAE (Whistlers and Allies)					
198.	Mangrove Whistler	*Pachycephala cinerea*	R	R**	LC
LANNIDAE (Shrikes)					
199.	Tiger Shrike	*Lanius tigrinus*	M	M**	LC
200.	Brown Shrike	*Lanius cristatus*	M	M**	LC
VIREONIDAE (Vireos)					
201.	White-bellied Erpornis	*Erpornis zantholeuca*	R	X	LC
ORIOLIDAE (Old World Orioles)					
202.	Dark-throated Oriole	*Oriolus xanthonotus*	?	X	NT
203.	Black-naped Oriole	*Oriolus chinensis*	R	R	LC
DICRURIDAE (Drongos)					
204.	Black Drongo	*Dicrurus macrocercus*	M	X	LC
205.	Ashy Drongo	*Dicrurus leucophaeus*	R,M	X	LC
206.	Crow-billed Drongo	*Dicrurus annectans*	M	M**	LC
207.	Bronzed Drongo	*Dicrurus aeneus*	R	R**	LC
208.	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	R	X	LC
RHIPIDURIDAE (Fantails)					

209.	Malaysian Pied-Fantail	*Rhipidura javanica*	R	X	LC
MONARCHIDAE (Monarch Flycatchers)					
210.	Black-naped Monarch	*Hypothymis azurea*	R	X	LC
211.	Asian Paradise-Flycatcher	*Terpsiphone paradasi*	R,M	R,M**	LC
CORVIDAE (Crows, Jays, and Magpies)					
212.	Black Magpie	*Platysmurus leucopterus*	R	X	NT
213.	Racket-tailed Treepie	*Crypsirina temia*	R	X	LC
214.	House Crow	*Corvus splendens*	I/F	I/F	LC
215.	Slender-billed Crow	*Corvus enca*	R	X	LC
216.	Large-billed Crow	*Corvus macrorhynchos*	R	R	LC
HIRUNDINIDAE (Swallows)					
217.	Barn Swallow	*Hirundo rustica*	M	M	LC
218.	Pacific Swallow	*Hirundo tahitica*	R	R	LC
219.	Red-rumped Swallow	*Cecropis daurica*	M	X	LC
220.	Asian House-Martin	*Delichon dasypus*	M	X	LC
STENOSTIRIDAE (Fairy Flycatchers)					
221.	Grey-headed Canary-Flycatcher	*Culicicapa ceylonensis*	R	X	LC
PARIDAE (Chickadees and Tits)					
222.	Sultan Tit	*Melanochlora sultanea*	R	X	LC
SITTIDAE (Nuthatches)					
223.	Velvet-fronted Nuthatch	*Sitta frontalis*	R	X	LC
PYCNONOTIDAE (Bulbuls)					
224.	Puff-backed Bulbul	*Pycnonotus eutilotus*	R	X	NT
225.	Black-headed Bulbul	*Pycnonotus atriceps*	R	X	LC
226.	Black-crested Bulbul	*Pycnonotus flaviventris*	R	X	LC
227.	Scaly-breasted Bulbul	*Pycnonotus squamatus*	R	X	NT
228.	Grey-bellied Bulbul	*Pycnonotus cyaniventris*	R	X	NT
229.	Red-whiskered Bulbul	*Pycnonotus jocosus*	F	X	LC
230.	Stripe-throated Bulbul	*Pycnonotus finlaysoni*	R	X	LC

231.	Yellow-vented Bulbul	*Pycnonotus goiavier*	R	R	LC
232.	Olive-winged Bulbul	*Pycnonotus plumosus*	R	R**	LC
233.	Streak-eared Bulbul	*Pycnonotus blanfordi*	R	X	LC
234.	Cream-vented Bulbul	*Pycnonotus simplex*	R	X	LC
235.	Red-eyed Bulbul	*Pycnonotus brunneus*	R	X	LC
236.	Spectacled Bulbul	*Pycnonotus erythropthalmos*	R	X	LC
237.	Hairy-backed Bulbul	*Tricholestes criniger*	R	X	LC
238.	Finsch's Bulbul	*Alophoixus finschii*	R	X	NT
239.	Ochraceous Bulbul	*Alophoixus ochraceus*	R	X	LC
240.	Grey-cheeked Bulbul	*Alophoixus bres*	R	X	LC
241.	Buff-vented Bulbul	*Iole olivacea*	R	X	NT
242.	Ashy Bulbul	*Hemixos flavala*	R	X	LC
243.	Mountain Bulbul	*Ixos mcclellandii*	R	X	LC
244.	Streaked Bulbul	*Ixos malaccensis*	R	X	NT
PHYLLOSCOPIDAE (Leaf-Warblers)					
245.	Dusky Warbler	*Phylloscopus fuscatus*	M	X	LC
246.	Arctic Warbler	*Phylloscopus borealis*	M	X	LC
247.	Pale-legged Leaf-Warbler	*Phylloscopus tenellipes*	M	X	LC
248.	Eastern Crowned Leaf-Warbler	*Phylloscopus coronatus*	M	X	LC
249.	Chestnut-crowned Warbler	*Seicercus castaniceps*	R	X	LC
ACROCEPHALIDAE (Reed-Warblers and Allies)					
250.	Black-browed Reed-Warbler	*Acrocephalus bistrigiceps*	M	X	LC
251.	Oriental Reed-Warbler	*Acrocephalus orientalis*	M	X	LC
LOCUSTELLIDAE (Grassbirds and Allies)					
252.	Lanceolated Warbler	*Locustella lanceolata*	M	X	LC
CISTICOLIDAE (Cisticolas and Allies)					
253.	Zitting Cisticola	*Cisticola juncidis*	R	X	LC
254.	Common Tailorbird	*Orthotomus sutorius*	R	R**	LC
255.	Dark-necked Tailorbird	*Orthotomus atrogularis*	R	X	LC

256.	Ashy Tailorbird	*Orthotomus ruficeps*	R	X	LC
257.	Rufous-tailed Tailorbird	*Orthotomus sericeus*	R	X	LC
258.	Rufescent Prinia	*Prinia rufescens*	R	X	LC
259.	Yellow-bellied Prinia	*Prinia flaviventris*	R	X	LC
ZOSTEROPIDAE (Yuhinas, White-eyes, and Allies)					
260.	Oriental White-eye	*Zosterops palpebrosus*	R	X	LC
261.	Everett's White-eye	*Zosterops everetti*	R	X	LC
TIMALIIDAE (Tree-Babblers, Scimitar-Babblers, and Allies)					
262.	Pin-striped Tit-Babbler	*Mixornis gularis*	R	X	LC
263.	Fluffy-backed Tit-Babbler	*Macronus ptilosus*	R	X	NT
264.	Chestnut-winged Babbler	*Cyanoderma erythropterum*	R	X	LC
265.	Black-throated Babbler	*Stachyris nigricollis*	R	X	NT
266.	Grey-throated Babbler	*Stachyris nigriceps*	R	X	LC
267.	Grey-headed Babbler	*Stachyris poliocephala*	R	X	LC
PELLORNEIDAE (Ground Babblers and Allies)					
268.	Moustached Babbler	*Malacopteron magnirostre*	R	X	LC
269.	Sooty-capped Babbler	*Malacopteron affine*	R	X	NT
270.	Scaly-crowned Babbler	*Malacopteron cinereum*	R	X	LC
271.	Grey-breasted Babbler	*Malacopteron albogulare*	R	X	NT
272.	Puff-throated Babbler	*Pellorneum ruficeps*	R	X	LC
273.	Black-capped Babbler	*Pellorneum capistratum*	R	X	LC
274.	Short-tailed Babbler	*Pellorneum malaccense*	R	X	NT
275.	White-chested Babbler	*Pellorneum rostratum*	R	X	NT
276.	Ferruginous Babbler	*Pellorneum bicolor*	R	X	LC
277.	Abbott's Babbler	*Turdinus abbotti*	R	X	LC
278.	Horsfield's Babbler	*Turdinus sepiarius*	R	X	LC
279.	Large Wren-Babbler	*Turdinus macrodactylus*	R	X	NT
280.	Streaked Wren-Babbler	*Turdinus brevicaudatus*	R	X	LC
LEIOTHRICHIDAE (Laughingthrushes and Allies)					

281.	Brown Fulvetta	*Alcippe brunneicauda*	R	X	NT
IRENIDAE (Fairy-bluebirds)					
282.	Asian Fairy-bluebird	*Irena puella*	R	X	LC
MUSCICAPIDAE (Old World Flycatchers)					
283.	Dark-sided Flycatcher	*Muscicapa sibirica*	M	X	LC
284.	Ferruginous Flycatcher	*Muscicapa ferruginea*	M	X	LC
285.	Asian Brown Flycatcher	*Muscicapa latirostris*	M	M**	LC
286.	Oriental Magpie-Robin	*Copsychus saularis*	R	R**	LC
287.	White-rumped Shama	*Copsychus malabaricus*	R	X	LC
288.	White-tailed Flycatcher	*Cyornis concretus*	R	X	LC
289.	Blue-throated Flycatcher	*Cyornis rubeculoides*	M	X	LC
290.	Hill Blue-Flycatcher	*Cyornis banyumas*	R	X	LC
291.	Tickell's Blue-Flycatcher	*Cyornis tickelliae*	R*	R	LC
292.	Mangrove Blue-Flycatcher	*Cyornis rufigastra*	R	X	LC
293.	Grey-chested Jungle-Flycatcher	*Cyornis umbratilis*	R	X	NT
294.	Siberian Blue Robin	*Larvivora cyane*	M	X	LC
295.	Chestnut-naped Forktail	*Enicurus ruficapillus*	R	X	NT
296.	Korean Flycatcher	*Ficedula zanthopygia*	M	M**	LC
297.	Green-backed Flycatcher	*Ficedula elisae*	M	M**	LC
298.	Blue Rock-Thrush	*Monticola solitarius*	R,M	X	LC
299.	Siberian Stonechat	*Saxicola maurus*	M	X	LC
TURDIDAE (Thrushes and Allies)					
300.	Siberian Thrush	*Geokichla sibirica*	M	X	LC
301.	Eyebrowed Thrush	*Turdus obscurus*	M	M	LC
STURNIDAE (Starlings)					
302.	Asian Glossy Starling	*Aplonis panayensis*	R	R	LC
303.	Common Hill Myna	*Gracula religiosa*	R	X	LC
304.	Daurian Starling	*Agropsar sturnina*	M	X	LC
305.	Common Myna	*Acridotheres tristis*	R	R	LC

306.	Jungle Myna	*Acridotheres fuscus*	R	R	LC
CHLOROPSEIDAE (Leafbirds)					
307.	Greater Green Leafbird	*Chloropsis sonnerati*	R	X	LC
308.	Lesser Green Leafbird	*Chloropsis cyanopogon*	R	X	NT
309.	Blue-winged Leafbird	*Chloropsis cochinchinensis*	R	X	LC
DICAEIDAE (Flowerpeckers)					
310.	Yellow-breasted Flowerpecker	*Prionochilus maculatus*	R	X	LC
311.	Crimson-breasted Flowerpecker	*Prionochilus percussus*	R	X	LC
312.	Scarlet-breasted Flowerpecker	*Prionochilus thoracicus*	R	X	NT
313.	Thick-billed Flowerpecker	*Dicaeum agile*	R	X	LC
314.	Orange-bellied Flowerpecker	*Dicaeum trigonostigma*	R	X	LC
315.	Plain Flowerpecker	*Dicaeum minullum*	R	X	LC
316.	Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	R	X	LC
NECTARINIIDAE (Sunbirds and Spiderhunters)					
317.	Ruby-cheeked Sunbird	*Chalcoparia singalensis*	R	X	LC
318.	Plain Sunbird	*Anthreptes simplex*	R	X	LC
319.	Plain-throated Sunbird	*Anthreptes malacensis*	R	R**	LC
320.	Van Hasselt's Sunbird (purple throated)	*Leptocoma brasiliana*	R	X	LC
321.	Copper-throated Sunbird	*Leptocoma calcostetha*	R	X	LC
322.	Olive-backed Sunbird	*Cinnyris jugularis*	R	X	LC
323.	Temminck's Sunbird	*Aethopyga temminckii*	R	X	LC
324.	Crimson Sunbird	*Aethopyga siparaja*	R	X	LC
325.	Little Spiderhunter	*Arachnothera longirostra*	R	X	LC
326.	Purple-naped Spiderhunter	*Arachnothera hypogrammicum*	R	X	LC
327.	Spectacled Spiderhunter	*Arachnothera flavigaster*	R	X	LC
328.	Grey-breasted Spiderhunter	*Arachnothera modesta*	R	X	LC
MOTACILLIDAE (Wagtails and Pipits)					
329.	Forest Wagtail	*Dendronanthus indicus*	M	X	LC

330.	Eastern Yellow Wagtail	*Motacilla tschutschensis*	M	X	LC
331.	Grey Wagtail	*Motacilla cinerea*	M	M	LC
332.	Paddyfield Pipit	*Anthus rufulus*	R	X	LC
333.	Olive-backed Pipit	*Anthus hodgsoni*	M	X	LC
PASSERIDAE (Old World Sparrows)					
334.	Plain-backed Sparrow	*Passer flaveolus*	R	X	LC
335.	Eurasian Tree Sparrow	*Passer montanus*	R	R	LC
PLOCEIDAE (Weavers and Allies)					
336.	Baya Weaver	*Ploceus philippinus*	R	X	LC
ESTRILDIDAE (Waxbills and Allies)					
337.	White-rumped Munia	*Lonchura striata*	R	X	LC
338.	Scaly-breasted Munia	*Lonchura punctulata*	R	X	LC
339.	Chestnut Munia	*Lonchura atricapilla*	R	X	LC
340.	White-headed Munia	*Lonchura maja*	R	X	LC

Legend:

- R=Resident, M=Migrant, V=Vagrant, F/I=Ferral/Introduced, X=No Confirmed Records or Does Not Occur, ? = Doubtful or Unconfirmed
- IUCN LISTING: CR= Critically Endangered, EN=Endangered, LC= Least Concern, NT= Near Threatened, VU=Vulnerable

Scientific Names and The IUCN Red List of Threatened Species is based on that as published by MNS (2015). The above bird list also includes all literature survey, and sightings up to September 2017.

Total species for Gunung Jerai and surrounding areas = 314
Total species for Song Song island chain and surrounding seas = 87
Total species for both areas = 337

*New Record for Gunung Jerai during expedition = 1
**New Record for Song Song island chain, during expedition = 16

Recommendations

The bird's study group would like to offer a few suggestions for the continuation of the bird's survey for these treasured Songsong-Jerai complex as below:

i. There is a need for more surveys at regular interval, which need to be carried out on the Songsong chain of island, including Pulau Bunting, Pulau Telur and Pulau Sayak especially during the autumn migratory season for migrating passerines.

ii. While the night survey for nocturnal owls on the islands and Gunung Jerai and surrounding areas are also important to capture the night activities.

iii. The raptor observations from the east of Gunung Jerai towards Sungkop Forest Reserve are especially crucial during the autumn migratory season.

iv. A Kedah State Bird Checklist survey have to be carried out in the near foreseeable future since the last checklist by Gregory-Smith (1995) had been undertaken more than 20 years ago.

v. Our last suggestion is for the Gunung Jerai complex to be made part of the secondary corridor to our Central Forest Spine (CFS) by connecting to the Sungkop FR especially for the winged fauna's connectivity.

Acknowledgements

We would like to extend our greatest gratitude for the invitation by the Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia and Department of Marine Park Malaysia under Ministry of Natural Resources and Environment (NRE) for inviting us to take part in this Biodiversity Expedition 2017. Our heartfelt appreciation as to James Ooi Teik Kok, Tulsi Ram Subedi, Neoh Hor Kee, Choy Wai Mun and Mohd Abdul Muin for their tremendous contribution. And also Puan Maznah Yusof, State Director for JTLM Kedah for extending assistance through logistic and boat crews during the biodiversity expedition. We are also indebted to all the expedition members from FRIM, Penang Botanical, DWNP Perak, and UUM for being a great companionship and sharing of information during the expedition.

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Figure 2.13.2. Birds of Songsong-Jerai (a) Pied Imperial Pigeon, Bidan (b) Pacific Reef Egret Dark Morph (c) Shearwater (d) Green Imperial Pigeon, Bidan (e) Rufous Collar King Fisher, (f) Island Fruit Bat.

2.14 SOCIO-ECONOMIC OF GUNUNG JERAI TO THE SONGSONG GROUP OF ISLANDS, KEDAH

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Abstract

This report provides the summary about socio-economic study, which is a part of the finding from H2O Songsong-Jerai Expedition 2017. The expedition was initiated by the Department of Marine Parks Malaysia with the aims to disclose the true biodiversity and socio-economic standing of Pulau Songsong and Gunung Jerai. This study explores the social, cultural and economic aspects in the land area of Gunung Jerai to the Songsong group of islands including the coastal region. The data and information of the study were gathered through literature review and observation on the study site. Four factors were focused during the data collection. The study attempts to demonstrate the sources of income of the local community, the value and culture, education levels and health status. Besides identifying the main economic activities, the social environment and also the quality of life of the local community the study also highlighted the potential value in the studied area that can be put forward to expand the economic activities of the community.

Introduction

Social, cultural, economic and political factors have significant influence in shaping the development, management and performance of an area (World Bank, 2006). Socio-economic factors directly influence social privilege and levels of financial independence as which explained the lifestyle components and measurement of financial viability and social standing such as income, education, environment and health status. Therefore, in order to develop a new region such as a new marine park area, socio- economic considerations for example the compatibility with local culture, food security, livelihood opportunities, monetary and non-monitory benefits, etc. are highly important (Pomeroy, Parks &Watson, 2004). This study aims to identify the main income or main economic activities of the local community; to explore the environment and cultural value of the societies; and to identify the potential value of the studied area.

Materials and Methods

This is a qualitative study, which discovers the socio-economic status of the communities in the studied area. The data and information for the research were gathered in the community natural setting through some interviews and conversations with the local communities and take pictures to provide photographs that able to frame the community behavior and belief (Creswell, 2007).

Results and Discussion

(a) Economic Activities

Economic activities can be defined as efforts which are undertaken by man to earn income, money, and wealth for his life and to secure maximum satisfaction of wants with limited and scarce means. Basically, economic activities can be divided into three sectors, which are primary, secondary and tertiary sectors. From lens evidence, primary sector that is agricultural contributed jobs to majority of the locals. Fishery and farming sectors are activities can be seen geographically as Yan mostly covered by paddy field and near to costal area. Apart from that, the secondary sector play crucial role in satisfying Yan communities requirement. It can be seen, abundant of small business scattered in the area of Yan such as retail stores, food court and kiosk, market, night market, etc. Some of the fishermen and farmers also sell their catches and crops in these markets (Figure 2.14.1). The tertiary sector which comprises of service sector support and balance Yan people day-to-day work life. Among these local people, they work in in privates and government in line with the existence of several private offices and government bodies such as school, clinic, hospital, police station, fire station, and district office in that area.

Figure 2.14.1. Economic activities of the residences at Yan, Kedah.

(b) Infrastructure

Infrastructure is the basic physical and organizational structures and facilities (e.g. buildings, roads, sewage, water, and power supplies) needed for the operation of a society or enterprise. It can be seen that the district of Yan is fully equipped with basic facilities such as water and electric supplies, transportation, communication, health, education and religion. Public hospitals, health center and clinics were provided to the locals to support their health status. Education facilities such as kindergarten, national primary school, Chinese national type school, secondary school, religious secondary school, and Community College were found in the area of Yan. There are quite a numbers of mosques were also found as the communities of Yan are dominated by Muslim (Figure 2.14.2).

Figure 2.14.2. Infrastructures at Yan, Kedah.

(c) Tourism Attraction

Yan is surrounded by beautiful flora and fauna that made the landscapes attractive for tourism spot. Most of the scenery is captured by rice paddy fields with occasional limestone hills towering over the surrounding plains, forests, lakes, mountain ranges and beautiful islands. Bounded by the trees, mount, and paddy field, most of the roads in the area of Yan are absolutely dazzling. There are a number of exciting things to do in Yan from historical sites to cultural attractions. Some of the topmost attractions in Yan are Gunung Jerai, Merdeka Beach Resort, Titi Hayun Waterfall, Puteri Mandi Waterfall, Pulau Songsong, Pulau Telur and Pulau Bidan, Terusan Wan Muhammad Saman, Sg. Batu and others (Figure 2.14.3).

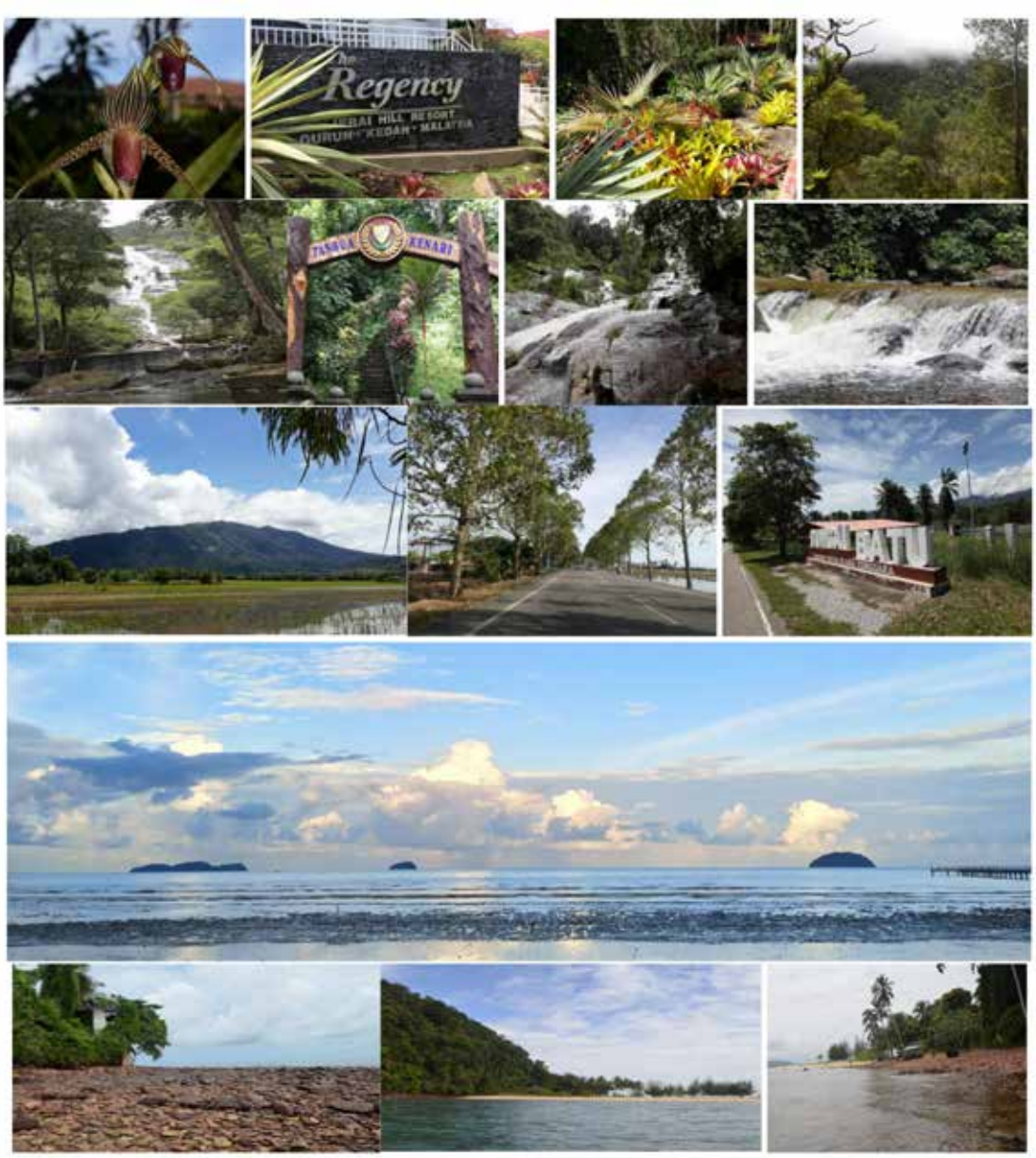

Figure 2.14.3. Tourist attractions at Yan, Kedah.

(d) Culture and Value

The culture and value are the predominating attitudes and behavior that characterize the functioning of a group or organization. The cultures of Yan are distinguished by the diverse ethnic background of people in Yan. With difference of language, belief and lifestyle, this has made them richer in cultural diversity and become the strength of their unity. People in Yan still value the relationship across races and generations. Though Malays are the vast majority population in Yan, most of the communities live peacefully and are able to develop their lives and enjoy their rights. In fact, they can become good friends and spend their leisure time together (Figure 2.14.4).

Figure 2.14.4. Culture and value of the locals at Yan, Kedah.

The locals in Yan love to spend their weekends with family, as they enjoy bringing their children on picnics. During the visit to the waterfall named Titi Hayun, it is common to see that the place was crowded with local people who really treasured their quality time with family. Other places like Pantai Murni Park are also full of local people who are seem to be having a great time with their families. The locals also love to enjoy the sunset when the night falls. During the expedition we managed to find one old lady that uses the traditional method to make mats by using the screw pine leaves. This indicates that the heritages of old generation still exist and preserved within the local communities. Apart from that, our lens captured the locals, especially the male gender who love to fish at the islands.

The awareness and attitudes towards conserving the natural marine resources are getting positive attention among the youth induced by Mr. Azim, one of the founders of non-profit organization called Lembah Bujang Lestari. According to Mr. Azim, this NGO had taken the initiative to preserve the sustainability of Pulau Bidan by conducting researches and programs relating conservation of the island.

Besides featuring the landscapes of Yan, we zoomed in our lens on the faces of local communities (Figure 2.14.5). These faces are the identity of Yan that documented in this expedition. The faces reflect the immediate impression of a nation illustrate a variety of colors in Yan. The local communities of Yan consist of diverse races, religion, economic status, and age level. Majority of them are Malays, followed by Chinese and Indians. Most of them live in harmony despite of different cultures and beliefs. From toddlers to teenagers, adult to senior citizens, all of them are affected by the development of Yan. Therefore, virtuous policies and efforts in conserving and protecting the natural treasures of Yan should be improved for future generations to enjoy.

Figure 2.14.5. Faces of Yan.

Recommendations

Since there are huge potential for tourism activities, the state government of Kedah should emerge with comprehensive policy framework to preserve and conserve the natural treasure of Yan. It is recommended that some tourist spots such as Gunung Jerai and Pulau Songsong ought to be gazetted as protected area to ensure the sustainability of the natural resources. It is advisable for Kedah state to have the collaboration with the federal state in promoting the awareness of the importance of environmental sustainability among local communities. Although there are many attractive spots in Yan, the information on these attractions are not yet delivered effectively to the local and international tourists. Therefore, Kedah state should take the initiative to aggressively promote these tourist spots by having their own tourism agency.

Conclusion

Based on the findings and our observation during the expedition, it is concluded that Yan possess outstanding natural beauty that can stimulate positive impact to the livelihood of the local communities. From highland to ocean, Yan can offer plenty of attractive destinations that will generate income to the people of Yan specifically and Kedah state in general. Comprehensive tourism activities and programs such as eco-based, coast, sport and cultural should be developed to generate more sustainability economy of Kedah.

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CHAPTER 3

SUMMARY AND RECOMMENDATION

The H2O (Highland to Ocean) Songsong-Jerai Expedition 2017 was commenced from 26th September to 3rd October 2017, an eight day expedition initiated to document the diversity of both the marine-coastal and terrestrial components of the habitats, biological communities and special areas of conservation from Pulau Songsong to Gunung Jerai. The expedition is a joint effort between Universiti Sains Malaysia (Centre For Marine & Coastal Studies) and the Department of Marine Parks Malaysia, in collaboration with nine institutions from the state and federal levels of nearly fifty biology and social scientists.

Diversity of Underwater and Intertidal Marine Organisms

The expedition revealed some of the true biodiversity and socioeconomic standing of Songsong group of Islands and Gunung Jerai. The diversity of hard corals on the reefs of Pulau Songsong remains the same after thirty years, however the condition of the reefs remains threatened with a significant reduction in live coral coverage. Pulau Songsong recorded 16 species, 13 genera and 9 families. Corals from the family Faviidae, Poritidae and Merulinidae were found to be dominant.

Soft coral remained abundant at Tukun Terendak compared to Pulau Songsong. Five more species were added to the checklist of the previous expedition held in the year 2012.

The terrestrial run-off from Merbok and Muda rivers are suggested to play significant role towards the reduction and will continue to affect the reefs and its associated organism. Bloom of *Ceratium furca* during the expedition further indicates the high nutrient discharge associated with these rivers.

The next significant reefs south of Songsong is Cape Rachado, but Songsong remains unique with its relationship and uniqueness to Pulau Payar and Langkawi, where it is still remains to be ascertained.

The diversity of sea cucumber remained the same over the years, *Holothuria (Mertensiothuria) leucospilota* being the dominant species and followed by *Stichopus fussiformiossa*. Based on the captured fishes throughout the expedition, a lot of information regarding fish stock, condition, abundance and recruitment could not be acquired due to the insufficient sample size. However, the number of fishing activity and the diversity of fish observed in this area indicate that this area is one of the special fish resource areas and should be protected. A total of two families (Holothuriidae and Stichopodidae), two genera and only two species were recorded in this expedition.

A total of 105 macrofauna were collected from coral reef and intertidal zone of Pulau Songsong, Kedah. The organisms encompassed 6 different phyla, namely Porifera, Echinodermata, Sipuncula, Annelida, Mollusca and Arthropoda. The largest number of organisms collected was from the class Ophiuroidea which represent the brittle stars. Molluscans were mainly represented by several species of gastropods and bivalves which were found encrusted deeply within the crevices of the coral boulders.

Fish inventory of Pulau Songsong conducted during the expedition has reported fifty individuals comprised of 16 species. Catch per unit effort (CPUE) was 0.55/person/hour with total weight of 9.35 kg. The largest fish captured was *Pomadasys kaakan* (javelin grunter @ gerut-gerut ompakan) followed by *Epinephelus coioides* (orange spotted grouper @ kerapu bitnik jingga). The most captured species was *Cephalopholis boeneck* (chocolate hind @ kerapu belang perang) followed by *Scolopsis vosmeri* (white cheek monocle bream @ pasir- pasir pipi putih) and *Nemipterus hexodon* (ornate threadfin bream @ kerisi pelangi).

Apart from that, compilation of previous research on marine mammals showed that there are significant populations of Humpback dolphin, Irrawaddy dolphin and Finless porpoise in this region, further investigation is still needed for the better understanding of the population size of each species and their movements. Meanwhile, bird group showed 17 new records out of the 337 species recorded during this expedition and this suggests that Songsong chain of islands and Gunung Jerai plays an important spot for the migrating passerines.

Diversity of Terrestrial Fauna

Various species of herpetofauna and small mammals were recorded in Gunung Jerai and Songsong group of Islands, where 14 species of herpetofauna have been recorded in Gunung Jerai area and 1 species in Songsong Island, comprising of 11 species of amphibians (*Rhacophoridae*, *Bufonidae*, *Dicroglossidae* and *Ranidae*) and 1 *Colubridae* (snake), 1 *Gekkonidae* (gecko), 1 *Agamidae* (lizards) and 1 *Scinidae*. There are still many herpetofauna species in this area and need to be preserved so that they are not extinct.

Apart from the herpetofauna and small mammals, the survey on bird diversity shows a total of 87 species recorded for the Songsong island chain, and its surrounding seas, and a total of 314 species recorded for Gunung Jerai and its surrounding areas. The total for the whole region is 337 species. The results indicate that the sea surrounding the Songsong chain of island has a large congregation of migratory terns, a regular site for the migratory short-tailed shearwaters, and three species of migratory jaegers or skuas. Various bird species are proposed as iconic to the Songsong island chain and the Gunung Jerai area for the purpose of conservation, including creating any marine park, state or national parks or eco-tourism destinations.

Diversity of Terrestrial Flora

Another important aspect that was focused during the expedition was the flora of the Songsong group of Islands and a section of Gunung Jerai. The preliminary survey conducted by FRIM and Penang Botanical Garden showed that the islands were covered by coastal and secondary species. At least 76 species of flora belonging to 51 families were recorded on the islands (Pulau Songsong, Pulau Bidan, Pulau Telur). This would be the first revision of the flora on the Songsong group of Islands in the Straits of Malacca.

Both the diversity of terrestrial fauna and flora of the islands and the Gunung Jerai are high and is an asset to the nation. A total of 108 herbarium collections of flowering and fruiting plants, which included about 55 families, 67 genera and 102 species, was collected. The most abundant families were Leguminosae and Rubiaceae. A few of interesting plants collected included endemic species, *Begonia sibthorpioides* Ridl. and a new record species to Gunung Jerai, *Fagraea splendens* Blume. Some rare and interesting plants were found during this expedition with fruiting and flowering materials collected that are important for taxonomic work. To sustain the diversity of flora and vegetation, proper management and legal protection are needed in order to conserve the remaining forest that are valuable for research, eco-tourism, nature education and research.

Gunung Jerai is now a national Geopark. An environmental education program with the long-term goal to increase resource use awareness by promoting direct participation and involvement of different stakeholders in environmental issue in the area is crucial. Particularly in determination of fishing buffer zone to sustain the resource. Since there are huge potential for tourism activities, the state government of Kedah should emerge with comprehensive policy framework to preserve and conserve the natural treasure of Yan to ensure the sustainability of the natural resources.

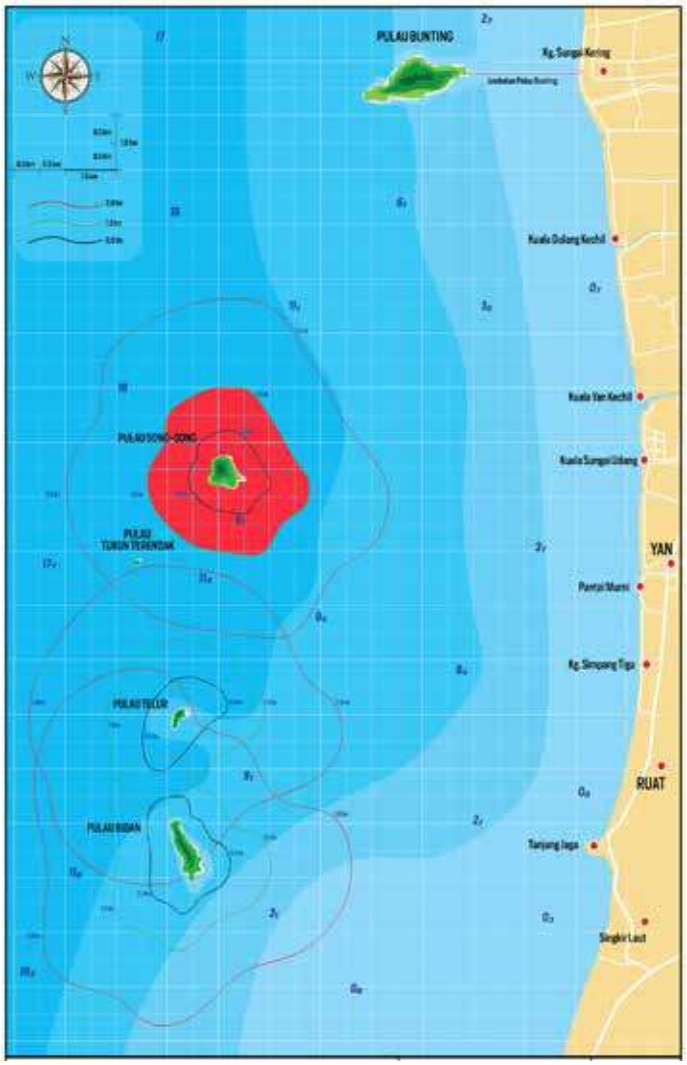
Socio-Economic of Songsong-Jerai

Yan possess outstanding natural beauty that can stimulate positive impact to the livelihood of the local communities. From highland to ocean, Yan is able to offer plenty of attractive destinations that will generate income to the people of Yan specifically and Kedah state in general. Comprehensive tourism activities and programs such as eco-based, coast, sport and cultural can be developed to generate more sustainability economy of Kedah. Tourist spots such as Gunung Jerai and Pulau Songsong ought to be gazetted as protected area to ensure the sustainability of the natural resources for the benefit of the local community and the State of Kedah as a whole. These multiple opportunities if sustainably utilised can bring great employment and will upgrade the livelihoods of these outskirt agricultural dependent community.

Recommendation for Kedah

Based on the preliminary survey in the surrounding areas of Songsong group of Islands and Gunung Jerai, high diversity of marine and terrestrial organisms were unexpectedly found and more to be explored.

The H2O Songsong-Jerai Expedition would seem to be the important source of information that will form the basis of the management for the human and natural habitats found here. The Marine Protected Area (in red) that could be recommended is either Category II (Habitat/ Species Management Area) or Category V (Protected Landscape/Seascape/Area) under the IUCN classification of MPAs. We hope it will help us conserve this important natural heritage for future generations. Finally, a thorough scientific study may lend a powerful support for the inclusion of the area into the Marine Park system.



NOTES: The demarcating of the proposed MPA boundary of Pulau Songsong (red solid filled area) was based on corals and not on the aspiration of other marine resources (red line is the two nautical miles boundary). Further detailed study may still be required.

Appendix

Appendix

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ISBN 978-967-0633-66-4
9 789670 633664